

Initial Environmental Examination

March 2016

BHU: Air Transport Connectivity Enhancement Project — Additional Financing

Prepared by Department of Air Transport, Royal Government of Bhutan for the Asian
Development Bank

CURRENCY EQUIVALENTS

(as of 3 March 2016)

Currency unit	-	ngultrum (Nu)
Nu1.00	=	\$0.01485
\$1.00	=	Nu67.336

ABBREVIATIONS

ADB	-	Asian Development Bank
ATCEP	-	Air Transport Connectivity Enhancement Project
BBSC	-	Bhutan Broadcasting Services Corporation
BHU	-	Basic Health Unit
BLSS	-	Bhutan living standard survey
CA	-	Competent Authority
CC	-	Construction Contractor
CDP	-	Capacity development project
CPS	-	Community Primary School
DA	-	Dzongkhag Administration
DC	-	Design Consultant
DCA	-	Department of Civil Aviation
DG	-	Diesel generator
DGM	-	Department of geology and mines
DOL	-	Department of the livestock
DYT	-	Dzongkhag Yargye Tshogdu
EC	-	Environmental Clearance
EIA	-	Environmental impact assessment
EMP	-	Environmental management plan
FMU	-	Forestry management unit
FNCA	-	Forest and nature conservation act
FNCR	-	Forest and nature conservation rules
GA	-	Geog administration
GLOF	-	Glacial lake outburst flood
GRF	-	Government reserve forest
ICAO	-	International civil aviation organisation
IEE	-	Initial environmental examination
JSWNP	-	Jigme Singye Wangchuk National Park
mASL	-	Meter above sea level
MCT	-	Main central thrust
MOAF	-	Ministry of agriculture and forests
MOIC	-	Ministry of information and communications
NEC	-	National Environment Commission
NFFDP	-	National feed and fodder development programme
NRDCL	-	Natural resources development corporation limited
NSB	-	National Statistics Bureau
ORC	-	Outreach clinic
PAVA	-	Property Assessment and Valuation Agency
PHCB	-	Population & Housing Census of Bhutan
PPD	-	Policy and Planning Division
PPTA	-	Project Preparation Technical Assistance
RGOB	-	Royal government of Bhutan
RMNP	-	Royal Manas National Park

ROW	-	Right of Way
RWSS	-	Rural water supply schemes
SPS	-	Safeguard policy statement
TOR	-	Terms of Reference

WEIGHTS AND MEASURES

dB	-	Decibel
Ha	-	Hectare
km	-	Kilometer
km ²	-	Square kilometer
m	-	Meter

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EXECUTIVE SUMMARY

A. Introduction

1. The Royal Government of Bhutan (RGOB) through the Department of Air Transport (DOAT) is committed to improving the domestic airports of Bumthang, Yonphula and Gelephu under the Asian Development Bank (ADB) assisted – Air Transport Connectivity Enhancement Project Additional Financing (ATCEP-AF). Under the ATCEP-AF, three sub-projects namely; i) construction of new passenger terminal building for Bumthang Domestic Airport (BDA); ii) erection of low level safety barriers along the perimeters of Yonphula Domestic Airport (YDA); and iii) construction of security staff quarters for Gelephu Domestic Airport (GDA) will be implemented.

2. Initial environmental examination (IEE) was prepared over a period of 3 months from December 2015 to March 2016 on behalf of the Department of Air Transport of RGoB. Field works were carried jointly with the design engineering team of the project.

3. The project has been classified as Category B in accordance with ADB's Environmental Assessment Guidelines (2003), and prepared in accordance with relevant laws and regulations of RGoB, including the Environmental Assessment Act (2000), the Regulation for the Environmental Clearance of Projects (2001) and with the ADB's Environmental Impact Assessment Guidelines, 2003; and the Safeguard Policy Statement 2009.

B. Description of the Project

4. The proposed new terminal building construction will be carried out within BDA at Batpalathang under Bumthang Dzongkhag. It is located 1km from center of Chamkhar town at an elevation of 2,570masl on a flat valley by left bank of Chamkhar Chhu/River runs parallel to the BDA runway.

5. Low level safety barrier will be constructed around the perimeters of the YDA runway. Yonphula airport is located at Yonphula under Kanglung Geog of Trashigang Dzongkhag which is approximately 30km from Trashigang, the Dzongkhag headquarter. The elevation of the airport is approximately 2750m ASL. The airport is connected to Samdrup Jongkhar – Trashigang highway by 0.7 km single lane access road from the south-east end of the airport.

6. The proposed security staff quarter will be constructed within GDA. The airport is located at the junction of Bhur (Samteling) and Gelephu Geogs in Sarpang Dzongkhag in southern Bhutan. It is located about 3 km from Gelephu and 30 km from Sarpang district head quarter. The Indo Bhutan Border is located within 1 km. Gelephu is the closest market place, which is located at Indo-Bhutan boarder (Datghari of Assam state of India). Airport is some 270 km (aerial distance) from Guwahati (State capital of Assam) and about 260 km (aerial distance) Thimphu. Figure 3 show the location of proposed security staff quarter construction zone.

C. Description of the Environment

7. **Geology:** The Bhutan Himalaya can be tectonically divided into three east west trending belts: the southern frontal belt, which includes the lesser Himalaya and the

foothills (Siwalik), the central crystalline belt, which includes greater Himalaya and the lesser Himalaya and the Tethyan belt, which includes portion of the greater Himalaya and portion of lesser Himalaya. Bumthang airfield falls in the Thimphu formation of the Higher Himalayan Belt. This formation is made up of pre-Cambrian metamorphic garnets and schist and granite gneiss, and is a prominent geological formation in Bhutan. Yongphula airfield lies on the boundary of Thimphu and Shumar formation. Shumar formation consists of metasedimentary rocks represented by phyllite, micaceous quartzite with rare limestone bands. Gelephu airfield falls in Quaternary formation of southern frontal belt borders with India in the south and comprises of boulder conglomerates, sand, silt and clay.

8. **Seismicity:** Bhutan falls within seismic risk zones IV and V. It is further divided into four hazard zones (very high, high, moderate and low). Bumthang airport falls under low earthquake hazard area. Gelephu and Yongphula airports lie in high and very high earthquake hazard zones respectively.

9. **Climate:** The country can be divided into three distinct climatic zones corresponding to the three main geographical divisions. Bhutan's climate is as varied as its altitudes and, like most of Asia; it is affected by the monsoons. The climate is humid and subtropical in the southern plains and foothills, temperate in the inner Himalayan valleys of the southern and central regions, and cold in the north, with year-round snow on the main Himalayan summits. Bumthang and Yongphula airports fall within inner Himalaya while Gelephu airport is in the humid and southern foothill.

10. **Rainfall:** Bumthang, Yongphula and Gelephu receive an annual average precipitation of 711.7mm, 1060.4 mm and 5326.0 mm respectively. The maximum monthly rainfall takes place in the month of June, July and August while the minimum monthly rainfall occurs in the winter months.

11. **Temperature:** August is observed as the hottest month of the year having mean daily maximum temperature of 22.5°C, 18.0 ° C and 30.4 °C for Bumthang, Yongphula and Gelephu airport sites respectively. Similarly, January is the coldest month having mean daily minimum temperature of -3.5 °C for Bumthang, 2.0 ° C for Yongphula and 13.2°C for Gelephu.

12. **Air environment:** A site-specific background air quality data concerning PM10, SO_x, and NO_x was collected for all airport sites for winter season in December 2015. The results ambient air quality show that the 24 hours value of TSPM and PM10 are within the national limit. The SO₂, NO_x, and CO is below the detectable limit for all three Project sites.

13. **Noise environment:** Baseline noise monitoring for all project sites were carried in December 2015. Noise levels for both day and night time of all three sites are within the national permissible standard for mixed areas (where residential, commercial, or both activities take place).

14. **Hydrology:** Bhutan has four major river systems: the Drangme Chhu; the Punatsang Chhu; the Wang Chhu and the Amo Chhu. Each flows swiftly out of the Himalayas, southerly through the Duars to join the Brahmaputra River in India. Chamkhar Chhu, which flow close to Bumthang airport, joins Mangde Chhu and Drangme Chhu to form Manas. Since the Chamkhar Chhu originates from the glacial lakes, there are risks of Glacial Lake Outburst Flood (GLOF) damaging the airport any time in future. Drangme

Chhu River falls within the 20 km radius of the Yongphula airport but there are no significant rivers or streams near the airport location. Mao Khola and Bhur Khola are river systems that lie within 20 km radius of the Gelephu airport. However, the Paitha Khola and Aiepuwali Khola streams are the ones that actually traverse or intersect the airport. These streams are seasonal, flows only during monsoon.

15. **Surface water quality:** The water quality tests have been carried out for all three project sites. Chamkar Chhu/River water quality is good whereas pond water quality of Yongphula is poor due to high turbidity and phosphate content. The high phosphate content in the natural water is one of the indicators of wastewater pollution.

16. **Ground water quality:** Ground water from bore well of Gelephu airport is very good.

17. **Protected Areas:** The Project does not fall in any of the protected areas or biological corridors of Bhutan.

18. **Forest cover:** There are no forest covers within the boundaries of three airports. The blue pine forest cover is the predominant forest outside the airport boundary of Bumthang. The cool broadleaf and subtropical forests are found outside the Yongphula and Gelephu airports respectively.

19. **Wildlife:** Pine forests are extensive in and around the Bumthang airport area particularly the slope towards the Pedtsheling monastery. The bird species such as pheasants, partridges, common crow, magpie and mammals such as goral, Himalayan yellow marten are known to occupy these habitats. The wildlife habitat immediately around Yongphula airport is poor due to the proximity to human habitat. However, further away from the human habitation, the abundance of wildlife (mammals and birdlife) is evident. Mammals such as Assamese Macaque, wild boar, barking deer, goral, Himalayan Serow, Sambar, leopard etc. are known to inhabit the areas further away from the human habitation. Although Yongphula area is quite rich birdlife there are no reports endangered or threatened bird species in the area. The subtropical forest around Gelephu Airport area is known for the richness of wildlife both mammals and birdlife. Mammals such as elephant, barking deer, rhesus macaque, Bengal fox, hares, jungle cat etc inhabit the area. The area is also rich in bird species which includes the beautiful Indian Peafowl (peacock) and Great Hornbill.

20. **Socio-economic Environment:** The domestic airports projects fall under of three dzongkhags namely, Bumthang, Trashigang and Sarpang. The total population of the three dzongkhags was enumerated in 2005 at about 106,448 persons with an overall average sex ratio (male/female) of 1.08. Within the geogs where airports are located there are about 29,910 persons. The Small Area Estimation of Poverty in Rural Bhutan, August 2010, jointly carried out by World Bank & NSB, shows the number of poor in the three dzongkhags to be 18,594 with the poverty rate of 15.5% for Bumthang, 30% for Trashigang and 23% for Sarpang. Poverty Analysis Report 2007 by NSB established the poverty line at Nu.1,096.94 per person per month. The principal crops grown in the project area include wheat, buckwheat, barley and rye in Bumthang; maize, rice and millet in Trashigang; and paddy, maize, millet, pulses, oranges, areca nut and cardamom in Gelephu. The sale of livestock and livestock products is another important source of income for farmers who rear all types of domestic animals available in Bhutan.

21. **Historical and Cultural Resources:** There are no physical cultural assets within the Project area.

D. Impacts and Mitigation Measures

22. This section discusses the potential environmental impacts of the proposed construction of new terminal building at Bumthang and staff quarters at Gelephu airports and identifies mitigation measures to minimize the impacts during construction and operational phases.

1. Construction Phase

23. **Impact of excavation and spoil disposal:** The construction of new terminal building and security quarters at Bumthang, and Gelephu airports respectively will require minimal excavation, filling and leveling of earth as the proposed both the construction sites on a flat land. Any extra excavated material could be easily used for filling and leveling of the undulated areas within the respective airports.

24. **Construction material and transportation:** Haphazard transportation of construction materials such as cement, sand, boulders etc. causes dust pollution along the haulage route. All access roads wherever there are possibilities of generating dust pollution within the Contractors jurisdiction shall be sprayed at least twice a day to minimize dust pollution. Regular maintenance of the construction vehicles will be carried out.

25. **Seismicity:** Bhutan falls under seismic zone IV and V which is high risk zone and the risk of earthquake is ever-present in Bhutan. Seismic events may cause damage to the structures and adjacent property, and result in loss of life. Earthquake risk has been incorporated into the detailed design of structures to minimize risk of earthquake related disaster.

26. **Water environment:** During construction surface and ground water resources may be affected by accidental spillage or by inappropriate management practices of hazardous substances into a river or streams and ground water channel. Wastewater/sewage and hazardous waste will not be dumped directly into the ground to avoid ground water pollution. For prevention of ground water contamination in Gelephu, pit latrine will be lined on sides with cement.

27. **Solid waste:** It is estimated that construction period about 6000 kgs of solid waste may be generated by the Project. This waste/garbage if not managed will pollute land and water bodies. Waste will be sorted into biodegradable and non-biodegradable. The biodegradable garbage shall be disposed off in a suitable landfill site or garbage pits. For every campsite, the contractor shall construct garbage pits. The non-biodegradable wastes like plastic bottle/paper/metallic wastes shall be collected and given to authorized scrap dealers for recycling. Hazardous waste such as spent batteries, acidic substances and used fuels shall be properly stored and sent for recycling.

28. **Sewage/Waste water:** Dumping of wastewater and sewage generated from the construction camps can pollute local water resources and causes water borne diseases. According WHO, the average wastewater generated by a single person is about 50litres per day. Project may generate roughly around 2750 litres of wastewater daily. Ordinary pit

toilets shall be constructed at Bumthang for sewage/wastewater treatment. Whereas especially cement lined or sealed pit toilet shall be constructed at Gelephu workers campsite to prevent leakage and contamination of ground water. Pit toilets once completed their usage shall be decommissioned by covering with soil and compacting it to prevent leakage of wastewater into surrounding environment.

29. **Air environment:** Dust generation is inevitable at and inside the construction sites throughout that period. It will also be generated alongside the haul routes while transporting construction materials. Dust is detrimental to health and safety of both construction workers and people nearby.

30. The construction areas and haulage route will be sprayed with water at least twice a day. Construction material will be covered during transportation and timely maintenance of vehicle and equipment. Provision for gas/face masks for construction workers to prevent direct inhalation of dust

31. **Noise environment:** Since the scale of construction is small, issue of noise pollution will be limited to the construction site only. Therefore construction noise may only impact the labourers working for the project. The construction workers will be provided with earplugs to minimize the noise impact.

32. **Ecological Environment:** Loss of Vegetation due to site clearance: There are no natural forests or trees in the project. There will be no loss of forest cover due to site clearance and hence no mitigation measures are recommended.

33. **Pressure on Forest Product:** The pressure of forest product due to presence of construction workers will be negligible. Nonetheless, contractor will provide cooking fuel either Liquefied Petroleum Gas or fuel wood from legal supplier to minimize the competition on local resources.

34. **Impact on Wildlife and Habitats:** There will be no direct impact on wildlife habitat due to Project implementation. However, indirect impact on wildlife are being anticipated such as illegal fishing in Chamkhar Chhu, Bumthang; and illegal hunting and trapping of wildlife at Yonphula and Gelephu by the construction workers. During the construction period, PCU/Contractor in coordination with DFO will organize special instruction and awareness raising training for the workforces to deter illegal fishing, hunting or trapping of wildlife. Forest officials of respective project sites shall make a surprise visit to campsite and other work areas to discourage the workers from illegal activities. Contractor will be held accountable for any illegal activities that are carried out by its workforce.

2. Socioeconomic and Cultural Environment

35. **Land Acquisition and Resettlement:** The project will not require any private land acquisition or demolition of standing structures as the construction works will be restricted within the DoAT's property boundaries of BDA, YDA and GDA. Hence there will be no resettlement issues for the project sites.

36. **Community Infrastructures:** There are no community infrastructure within or in the vicinity of the Project sites of BDA, YDA and GDA. Hence no impacts are anticipated.

37. **Occupational Health, Safety and Wellbeing of Construction Workers:** During construction the health and safety of the workforce will be at risk from accidents, long shifts and through accommodation at a campsite. To minimize the risks associated with these conditions, Project will be responsible to ensure that adequate health care, proper shelter; safe drinking water, and toilet facilities are available at the site throughout the construction period.

38. **Communicable Diseases (HIV/AIDS/Tuberculosis), and Human Trafficking:** During construction phase, the project may employ local communities and also import number of skilled/semi-skilled foreign labourers for the construction works. The import and presence of large number of foreign workers increase the chances of spread of communicable diseases such as HIV/AIDS, tuberculosis etc. RGOB makes it mandatory for the foreign workforces undergo compulsory test for HIV/AIDS and communicable diseases. Only those who are free of diseases are awarded work permit. To minimize the risk of spread of the communicable diseases, the contractors and their workforces shall be made aware of the danger of diseases through educational campaigns. For example, Health Information and Service Center (HISC) or Dzongkhag Health Sectors in the respective project areas of Bumthang, Yonphula and Gelephu shall be invited to provide awareness education on sexually transmitted and other communicable diseases.

3. Operational Phase

39. **Air and Noise Environment:** The air and noise pollution during operation will not be severe as the number of traffic will be limited to maximum of thrice a week. And it may remain that way for foreseeable future. But nonetheless, by applying the ICAO Balanced Approach concept, the airports can manage aircraft noise and air pollution problems in an environmentally responsive and economically responsible way.

4. Waste Management

40. **Solid Waste:** During operation, it is estimated that there will be maximum of 3-4 flights per week to all three domestic airports. The estimated solid waste generation is roughly around 252kg per week and monthly around 1000kg. The airport management shall sort their garbage into biodegradable and non-biodegradable. The biodegradable garbage shall be disposed off in suitable landfill sites of respective municipalities. The non-biodegradable wastes like plastic bottle/paper/metallic wastes shall be collected and given to authorized scrap dealers for recycling. Hazardous waste such as spent batteries, acidic substances and used fuels shall be properly stored and sent for recycling to India.

41. **Sewage and Wastewater:** Dumping of wastewater and sewage generated from the airport operation can pollute local water resources and causes water borne diseases. According WHO, the average wastewater generated by a single person is about 50litres per day. Estimated wastewater generation by the Project will be roughly around 4000 litres per week. BDA and GDA shall construct septic tanks and soak pit to treat wastewater and sewage generated from the new terminal building and security staff quarters respectively to prevent contamination of ground and surface water. Septic tanks and soak pits shall be replaced with more advance wastewater treatment plant (eg. with Sequential Batch Reactor Plant) in future as the amount of wastewater generation increases beyond the capacity for septic tanks and soak pits to handle.

E. Environmental Management and Monitoring Plan

42. The Environmental Management and Monitoring Plan (EMP) will serve as a guideline for incorporating environmental measures and monitoring to be carried out by DoAT, the project manager, contractors and other parties to mitigate possible impacts of the Project.

43. DoAT through the project manager is responsible for ensuring that (i) all required mitigation measures that need to be incorporated into the project design are passed onto the engineering consultants, (ii) the bidding document for contractor contains all required mitigation measures to be implemented during the construction period and contractors' obligations to implement the EMP during construction, (iii) the environmental clearance is obtained before commencement of civil work in the relevant section of project roads, (iv) implementation of EMP is monitored regularly as required and the annual report on implementation of the EMP is well documented, (v) other parties and government agencies implement the EMP at all stages of the Project, (vi) remedial actions are undertaken in response to unpredicted environment impacts, and (vii) additional environmental assessment is undertaken if any change in project design takes place.

44. To ensure that contractors comply with the provisions of the EMP, the following specifications should be incorporated in all construction bidding documents: (i) the environmental mitigation measures and environmental monitoring works that need to be implemented by the contractor; (ii) environmental clauses for contract conditions and specifications; and (iii) the IEE reports.

F. Conclusion and Recommendation

45. Since the scale of the Project (Air Transport Connectivity Enhancement Project Additional Financing) is very small, it will have minimum impact on environment; and further all the construction activities will be carried out within the airport boundaries. From the IEE studies, it can be safely concluded that all three domestic airports of BDA, YDA and GDA:

- Do not fall under any protected and restricted forest areas, or biological corridors connecting protected areas of Bhutan;
- There will be no forest clearance or tree felling required;
- No private structure and land acquisition is required since project sites are all within the airport boundaries;
- Hence no resettlement is anticipated;

46. It is recommended that the environmental conditions are incorporated into standard bidding document and the EMP is attached with Bid document.

I. INTRODUCTION

A. Background

1. The Royal Government of Bhutan (RGOB) through the Department of Air Transport (DOAT) is committed to improving the domestic airports of Bumthang, Yonphula and Gelephu under the Asian Development Bank (ADB) assisted – Air Transport Connectivity Enhancement Project Additional Financing (ATCEP-AF). Under the ATCEP-AF, three sub-projects namely; i) construction of new passenger terminal building for Bumthang Domestic Airport (BDA); ii) erection of low level safety barriers along the perimeters of Yonphula Domestic Airport (YDA); and iii) construction of security staff quarters for Gelephu Domestic Airport (GDA) will be implemented.

2. BDA is located in the heart of Chamkhar valley at the place known as Bathbalathang within the Bumthang Dzongkhag (central northern district of Bhutan) at an elevation of 2637meters above sea level (masl). The airport has a total area of 119.47 acres. The first commercial flight to and from Paro was started on December 17, 2011.

3. YDA is located in Yonphula under Kanglung Geog some 30km drive north of the Trashigang district headquarter. The airport is connected to Samdrup Jongkhar – Trashigang highway by 0.7 km single lane access road from the south-east end of the airport. The airport is currently under major rehabilitation works and hence there are no flights from and to this airport.

4. The GDA is located at the junction of Bhur (Samteling) and Gelephu Geogs in Sarpang district in southern Bhutan. It is located about 3 km from Gelephu and 30 km from Sarpang district head quarter. The first commercial flight inauguration was done on December 17, 2015.

5. Druk Air is the only fixed wing domestic air carrier that currently operates domestic flights to Bumthang and Gelephu. It conducts three flights a week to Bumthang on a regular basis and once to Gelephu. On top of the Druk Air's flight, BDA and GDA also receive helicopter flights which are operated by Royal Bhutan Helicopter Services.

6. With the increasing number of air travelers to and from BDA, it now faces acute shortage of airport terminal space for passengers and crews services. The existing BDA terminal building is designed to handle maximum of 10-15 passengers at a given time and this terminal capacity has already been surpassed due to increased air travelers in recent years. In this light, the DoAT felt the necessity to have larger passenger terminal building which could handle the increasing number of air travelers. DoAT therefore requested the ADB's assistance to conduct feasibility study, design and fund the construction of the new airport terminal building under ATCEP-AF.

7. In the case of GDA, because of its proximity to the international boundary and the volatile security situation across the border; the need for stationing of permanent security personnel is of utmost importance for the safety of aircraft and the passengers. In this view, DoAT plans to conduct feasibility study, design and fund the construction of security staff quarters under ATCEP-AF with ADB assistance. This Initial Environment Examination (IEE) report is hence the part of the overall feasibility studies for preparation of the ATCEP-AF. The IEE study documents the potential impacts of the New Passenger Terminal Building Construction Project and its environment management measures. The

Project consists of constructing a new terminal which will completely replace the old Terminal building and house the functional areas that had previously operated at an old Terminal. The objective of the IEE study is to identify potential environmental impacts of the project to create strategies to avoid or mitigate the negative impacts, if any, which could arise due to the implementation of the project.

B. Project Area (Study Area)

8. The area that will be impacted by the sub-project during construction and operation does not coincide with its ultimate physical boundaries. The type and range of various expected direct and indirect environmental impacts therefore need to be fully understood at the earliest possible stages of the EIA study.

9. Based on the results of the initial scoping of potential environmental impacts and the identification of sensitive receptors we have identified the following geographical areas likely to be affected at the various stages of the sub-project:

10. During construction, temporary and permanent impacts will occur both on-and off-site. The most direct physical impact will be on-site in the area of the actual physical interventions which is estimated to be about 500m radius from the construction zone.

11. During operation of the passenger terminal building and the staff quarters, most impacts will be confined to the area that will be affected by construction impacts. Waste generation particularly solid waste and wastewater from the operation of the terminal building and may impact the immediate surroundings and the downstream water bodies such as Chamkhar Chhu/River in Bumthang, and the Paitha and Aiepuwali kholas in Gelephu.

12. Hence, the boundaries of the study or project area will vary according to the impacts expected at different phases of the sub-project implementation.

13. The three sub-projects of New Airport Terminal Building at BDA, erection of low level safety barrier at YDA and Security Staff Quarter at GDA will be hereafter referred to as "Project" and sub-project areas as "Project Area" to maintain consistency in reporting.

C. Data Source, Collection, Analysis and Reporting

14. Primary observation from site surveys and published information are the two main types of source material.

15. Feasibility study was carried out over period 2 months starting from December 2015 – January 2016. The environmental baseline data which included physical, biological and socioeconomic components were collected using both structured and non-structured questionnaires.

16. Physical baseline data on air, noise and water quality for this IEE study were derived from a baseline survey conducted during month of 16th – 30th December 2015. These baseline data will be used for subsequent monitoring during construction and operational phase.

17. Ecological data were collected using transect survey method which estimates the occurrence of flora and fauna within project area. The surveys were carried out during dry season in the month of December 2015.

18. Both primary and secondary data were compiled and analyzed using Geographic Information System (GIS) and other statistical software. Based on the analysis, the likely impacts were predicted; and subsequent mitigation measures were proposed, to minimize, to offset and to avoid the predicted impacts. IEE report was prepared under guidance of ADB Safeguard Policy Statement (SPS) and RGOB's environmental laws and regulations.

19. The feasibility IEE study team included the following officials and experts:

Table 1: Key Personnel/Experts involved in carrying out IEE Studies

SNo	Name	Designation	Expertise
1	John Pashen	Team Leader	Aviation Planning Expert
2	Robert Heywood	Pavement Specialist	Pavement design
3	Shanti Ram Katel	Contract Specialist	Contract management
4	P.L. Sharma	Geotechnical Expert	Geotechnical investigations
5	Karma Chogyel	Environmental Specialist	Environment and social studies

Figure 1: Location of Domestic Airports in Bhutan



II. PROJECT DESCRIPTION

A. Project Location

20. Project sites are spread over three domestic airports of Bumthang, Yonphula and Gelephu.

21. The proposed new terminal building construction will be carried out within BDA at Batpalathang under Bumthang Dzongkhag. It is located 1km from center of Chamkhar town at an elevation of 2,570masl on a flat valley by left bank of Chamkhar Chhu/River runs parallel to the BDA runway. Figure 2 shows location of new terminal building at BDA.

Figure 2: Location of Proposed New Passenger Terminal Building at Bumthang Domestic Airport



22. Low level safety barrier will be constructed around the perimeters of the YDA runway. Yonphula airport is located at Yonphula under Kanglung Geog of Trashigang Dzongkhag which is approximately 30km from Trashigang, the Dzongkhag headquarter. The elevation of the airport is approximately 2750m ASL. The airport is connected to Samdrup Jongkhar – Trashigang highway by 0.7 km single lane access road from the south-east end of the airport.

23. The proposed security staff quarter will be constructed within GDA. The airport is located at the junction of Bhur (Samteling) and Gelephu Geogs in Sarpang Dzongkhag in southern Bhutan. It is located about 3 km from Gelephu and 30 km from Sarpang district head quarter. The Indo Bhutan Border is located within 1 km. Gelephu is the closest market place, which is located at Indo-Bhutan boarder (Datghari of Assam state of India). Airport is some 270 km (aerial distance) from Guwahati (State capital of Assam) and about 260 km (aerial distance) Thimphu. Figure 3 show the location of proposed security staff quarter construction zone.

Figure 3: Location of Proposed Security Quarter at Gelephu Domestic Airport



B. Construction Material Requirement

24. The construction materials like sand, aggregate and stones for the construction of new terminal building will be sourced from the established quarries.

25. Cement will be imported from Pagli, Gomtu under Samtse district via India through a border of Phuentsholing. Steel will be brought from Pasakha, Phuentsholing.

C. Construction Equipment

26. The construction equipment that will be used by the Project will be Hydraulic Excavator; JCB Loader/Backhoe; trucks; Concrete Mixer, compressors, Duct Dewatering etc.

III. ENVIRONMENTAL POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

27. RGOB has adopted various acts, regulations, policies and guidelines to ensure the any development plans and program are sustainable and environmental friendly. In addition to these, Bhutan is signatory to twelve multilateral environmental agreements including those on biodiversity, climate change, climate change-Kyoto protocol, desertification, endangered species and hazardous wastes.

28. The IEE study was being guided by the requirements and provisions of the applicable acts, rules and guidelines as follows:

Table 2: Legal Framework and their applicability to the Project

Legislations, guidelines & Policies	Key Requirements	Applicability		Reasons for Applicability
		Construction	Operation	
ADB's Safeguard Policy Statement (SPS) 2009	ADB policy requires that an Environmental Impact Assessment (EIA) Report be prepared by the borrower in accordance with ADB EA requirements and that loans or grants are classified according to their potential impact on the environment.	Applicable	Applicable	Since the scale, extent and magnitude of the project are small in nature; it is classified as Environmental Category B project. Accordingly, IEE study was carried out in accordance with the ADB's SPS and "A Good Practice Sourcebook, Draft Working Document, Environment Safeguard, December 2012,"
National Environmental Protection Act (NEPA) 2007	NEPA in its preamble states that Bhutan shall adhere to the principles of sustainable development and respect international environmental laws such as UFCC & UNCBD. Further it requires any developmental policies, plans and programs to be in harmony with the environmental principle.	Applicable	Applicable	Any development activities including the construction of terminal building at BDA though not so significant would contribute greenhouse emission both during construction and operation.
Environmental Assessment Act (EAA) 2000	Any development project before implementation, to through environmental assessment which may be either IEE or an EA depending upon the	Applicable	Applicable	Construction of new domestic terminal building is a small scale project both in terms size, extent and magnitude of the project works. Hence

Legislations, guidelines & Policies	Key Requirements	Applicability		Reasons for Applicability
		Construction	Operation	
	location, type and size of the projects.			the Implementing Agency (DoAT) is required to prepare an IEE level report.
Regulation for Environment Clearance of Projects (RECOP) 2002	Minimum public consultation requirement is set. Affected communities or stakeholders have to be informed through written notice or newspaper.	Applicable	Not applicable	General public or community consultation involving was not deemed necessary as there new terminal building is well within the airport boundary and no direct impact on the communities. Hence only the important stakeholders were consulted.
Strategy for air quality assessment and management in Bhutan, 2010	Baseline ambient quality of the all sensitive areas such as settlements and critical habitat areas has to be determined for future air quality monitoring. Baseline air quality will be assessed prior to the start of construction works.	Applicable	Applicable	Construction activities are expected to cause air pollution mainly due to construction generated dust and emissions from operation of construction equipment. Although minimal, some air pollution is also expected to occur during operation of road.
Waste Prevention and Management Act of Bhutan, 2009	To protect human health through protection of environment with proper handling, storage and disposal of hazardous and non-hazardous wastes	Applicable	Applicable	Construction works will generate waste which will need to be disposed of safely to prevent downstream water pollution and siltation. Construction works also expected to generate other solid (municipal waste) and hazardous liquid waste. Hazardous waste such spent oils will have to stored and recycled

Legislations, guidelines & Policies	Key Requirements	Applicability		Reasons for Applicability
		Construction	Operation	
				<p>wherever feasible.</p> <p>During operation, there are chances of spilling both hazardous and non-hazardous waste.</p>
<p>Waste Prevention and Management Regulation of Bhutan, 2012</p>	<p>Regulation prohibits illegal dumping or releasing of waste into the environment.</p> <p>Any organization or persons will be prohibited from disposing waste in manners other than as prescribed by this regulation.</p>	Applicable	Applicable	<p>Construction activities will generate spoil, which will need to be disposed of safely to prevent downstream water pollution and siltation. Construction works also expected to generate other solid (municipal waste) and hazardous liquid waste. Hazardous waste such spent oils will have to stored and recycled wherever feasible.</p> <p>During operation, there are chances of spilling both hazardous and non-hazardous waste.</p>
<p>Forest and Nature Conservation Act (FNCA) 1995;</p> <p>Forest and Nature Conservation Rules (FNCR) 2006; and</p> <p>Rules on Biological Corridor 2007</p>	<p>FNCA and its regulations require the proponent to process and seek the forestry clearance prior to the start construction through forest and critical habitats.</p> <p>FNCR rule 9 (2.9) sets out the procedure for tree felling. Only the marked trees within the prescribed construction corridor can be felled. FNCR strictly prohibits killing, injuring, destroying, capturing or collecting of wildlife.</p>	Not Applicable	Not Applicable	<p>The proposed construction of new terminal building, erection of safety barriers and Security quarter at BDA, YDA and GDA respectively are completely within airport boundaries and does not require any forest clearance or even single tree felling.</p> <p>There are no critical wildlife habitats or presence of any species belonging to Schedule I of FNCA</p>

Legislations, guidelines & Policies	Key Requirements	Applicability		Reasons for Applicability
		Construction	Operation	
	Schedule I provides the totally protected wildlife of Bhutan.			within or in the vicinity of the proposed construction site.
Land Act 1979 (amended in 2007); and Land Compensation Rate 2009	<p>Act requires any land acquisition whether public or private to be done as per the established procedure.</p> <p>For private land acquisition, the number of affected families' needs to be identified. Resettlement plan and compensation have to be worked out.</p> <p>Act also requires Government to provide land substitution instead of cash compensation while acquiring land. Allotment of all substitute land shall be from the same Dzongkhag.</p> <p>For structural acquisition, compensation has to be carried out by qualified engineer.</p> <p>Land compensation Rate 2009 will govern the compensation of land and structures.</p>	Not Applicable	Not Applicable	The proposed construction of new terminal building, erection of safety barriers and Security quarter at BDA, YDA and GDA respectively are completely within airport boundaries.
General Rules and Regulations on Occupational Health And Safety (OHS) in Construction, Manufacturing, Mining and Service Industries 2006	OHS Rule prescribes the minimum safety standards to be followed for the construction works. This includes personal protective and lifesaving equipments, fire protection hand and power tools, signs, signals & barricades, Material handling, storage, use and	Applicable	Applicable	Proposed construction of airport terminal building will employ number of construction workers. For the safety and the wellbeing of the workers, the OHS rules will have to be strictly implemented to minimize health and life risk

Legislations, guidelines & Policies	Key Requirements	Applicability		Reasons for Applicability
		Construction	Operation	
	disposal, Scaffolds, Excavations, Electrical works, Sanitation and Hygiene			associated while constructing road through hazardous condition. During operational period, safety of maintenance workers will have to be ensured through provision of OHS rule.

29. The project is being developed within a framework based on the policies and guidelines of the ADB and the laws, regulations and guidelines of the RGoB. ADB's SPS and Good Practice Sourcebook for Environment Safeguard, December 2012 are ADB's framework documents. While the RGoB's framework documents are the Environmental Assessment Act (2000), and Regulation for the Environmental Clearance of Projects (2002). Other regulations of the RGoB require prior clearance for the implementation of the project activities.

IV. ENVIRONMENTAL PROFILE OF THE PROJECT AREA

A. Physical Environment

1. Climate

30. Climate and meteorology of a place can play an important role in the implementation of any developmental project. Meteorology is also the key to understand local air quality, as there is an essential relationship between meteorology and atmospheric dispersion involving wind in the broadest sense of the term.

31. The country can be divided into three distinct climatic zones corresponding to the three main geographical divisions. Bhutan's climate is as varied as its altitudes and, like most of Asia; it is affected by the monsoons. Western Bhutan is particularly affected by monsoons that bring between 60 and 90 percent of the region's rainfall. The climate is humid and subtropical in the southern plains and foothills, temperate in the inner Himalayan valleys of the southern and central regions, and cold in the north, with year-round snow on the main Himalayan summits. Bumthang and Yongphula airports fall within inner Himalaya while Gelephu airport is in the humid and subtropical southern plain.

32. Temperatures vary according to elevation. Temperatures in Bumthang, which is located at an elevation of 2,570 meters above sea level in central Bhutan, range from approximately 14° C to 22° C during the monsoon season of June through September but drop to between about -3.5° C and 11° C in January. Most of the central portion of the country experiences a cool, temperate climate year round. In the south, a hot, humid climate helps maintain a fairly even temperature range of between 15° C and 30° C year-round, although temperatures sometimes reach beyond 35° C in the valleys during the summer.

33. Annual precipitation ranges widely in various parts of the country as shown in the figure 4. In the severe climate of the north, there is only about forty millimetres of annual precipitation-primarily snow. In the temperate central regions, a yearly average of around 1,000 millimetres is more common, and 7,800 millimetres per year has been registered at some locations in the humid, subtropical south, ensuring the thick tropical forest. Table IV-1 provides the summary of temperature and rainfall within project areas.

34. **Precipitation:** Bumthang receives a total annual average precipitation about of 765 mm. Most of the precipitations are seen during monsoon season starting from June till August. From the 16 years of rainfall records, the month of July is seen to have highest downpour with the total monthly average of 156mm. December is the driest month of the year for Bumthang as per the rainfall records with little or no rainfall at all. Refer Figure 4.

35. Yongphula receives an annual average precipitation of 1060.4 mm. The maximum mean monthly rainfall of 223.8 mm occurs during July while the mean minimum monthly rainfall of 0.0 mm takes in the month of January.

36. Of the three airport sites, Gelephu falls in the high precipitation zone with the annual average rainfall of 5326.0 mm. The maximum mean monthly rainfall of 1538.4 mm takes place in the month of June while the mean minimum monthly rainfall of 0.0 mm occurs in the month of February

Figure 4: Rainfall Pattern (average annual rainfall in mm) and Bumthang Airport Location

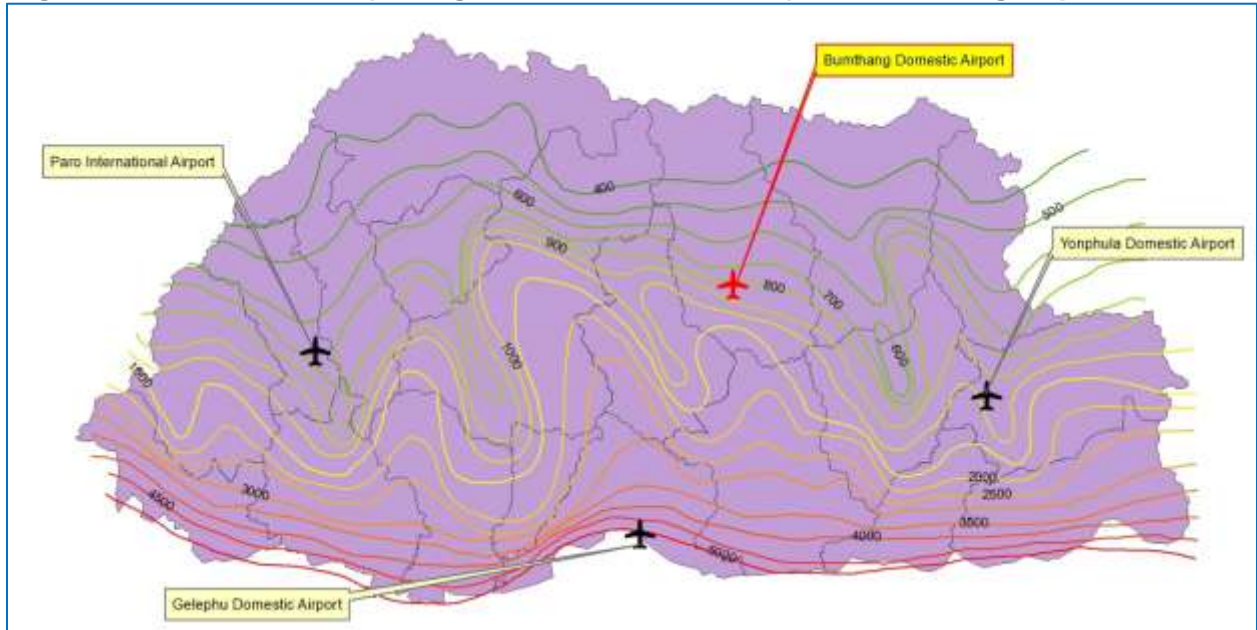
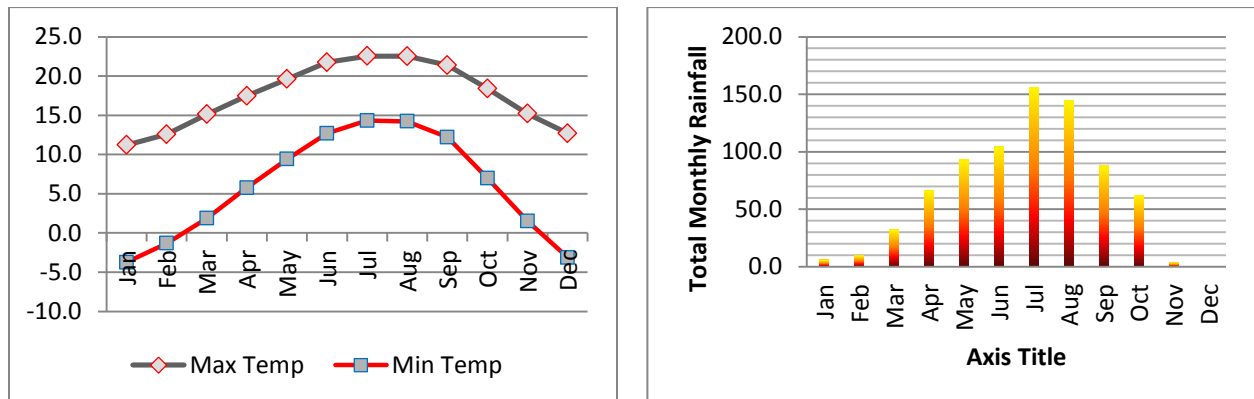


Figure 5: Average Monthly Temperature and Total Monthly Rainfall of Chamkhar Town between 1996-2011



Source: Meteorology Section, Hydromet Services Division, Department of Energy, MTI, Thimphu, Bhutan

37. Near Surface Temperature: July and August are observed as the hottest months of the year having mean daily maximum temperature of 22.5 ° C and January is the coldest month with mean daily minimum temperature of -3.8 ° C. Refer Figure 5.

38. Wind Direction and Speed: Wind direction is reported as the direction from which the wind blows and is based on surface observations. For Yongphula and Gelephu wind direction is predominantly from south-west where as for Bumthang it is predominantly from south-east direction. Table 3 provides average annual wind speed, direction and visibility within the project area.

Table 3: Wind speed, direction and visibility of the project areas

Parameter	Bumthang (2010 Average Reading)	Yongphula (2010 Average Reading)	Gelephu (2009 Average Reading)
Direction	164°	198.33°	201.33°
Speed	3.0	6.50	1.67
Visibility	9609.33	6350.25	9517.92
Anemometer Reading (m/s)	14364.57	55803.58	53818.08

Source: Department of Civil Aviation, 2011.

2. Geology of the Project Area

39. The Bhutan Himalaya can be tectonically divided into three east west trending belts:

- The southern frontal belt, which includes the lesser Himalaya and the foothills (Siwalik)
- The central crystalline belt, which includes greater Himalaya and the lesser Himalaya
- The Tethyan belt, which includes portion of the greater Himalaya and portion of lesser Himalaya.

40. The southern frontal belt borders with India in the south and comprises a very narrow strip of Tertiary Siwalik rocks represented by sandstone, mudstone, siltstone and boulder conglomerates. The Lesser Himalaya north of the Main Boundary Fault/Thrust (MBT) is represented by the rocks of Permian-Paleozoic formations. These formations from south to north are the Damuda, Baxa Group and the Shumar.

41. Damuda Formation consists of sandstones, shale with coal seams, felspathic quartzite and carbonaceous shale Buxa Group consists of dolomite, variegated quartzite and conglomerates represented by different formations like Jainti, Manas, Phuentsholing and Pangsari.

42. Shumar formation consists of metasedimentary rocks represented by phyllite, micaceous quartzite with rare limestone bands.

43. The central Crystalline Belt over thrusts the southern frontal belt through the Main Central Thrust (MCT) This belt covers most of the Bhutan's Himalayan area, represented by high grade metamorphic and intrusive rocks of Paro Thimphu group (Pre-Cambrian to Tertiary). Rocks of Paro are represented by quartzite, quartz-mica schist, marble, calcisilicate and graphitic schist while rocks of Thimphu are represented generally by granite, gneiss, migmatites and occasionally by granite-mica schist, felspathic schist and amphibolite.

44. The Tethyan Belt covers portions of Northern Higher Himalaya range, Crystalline Belt of the central and eastern part of Bhutan Himalaya. It consists of various rock information's and is represented by sedimentary rocks (Pre-Cambrian to Cretaceous) intruded by Tertiary granites. The main rock types of this belt are shale, phyllite, slate, calcareous phyllite, quartzite and limestone with intrusive granite.

Figure 6: Bumthang airport location in relation to Geology of Bhutan

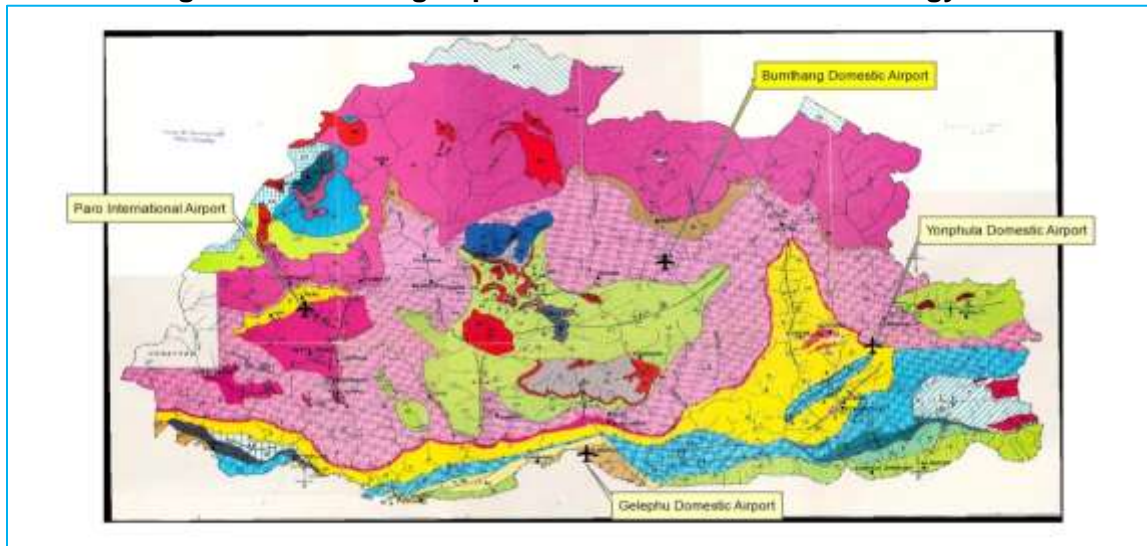
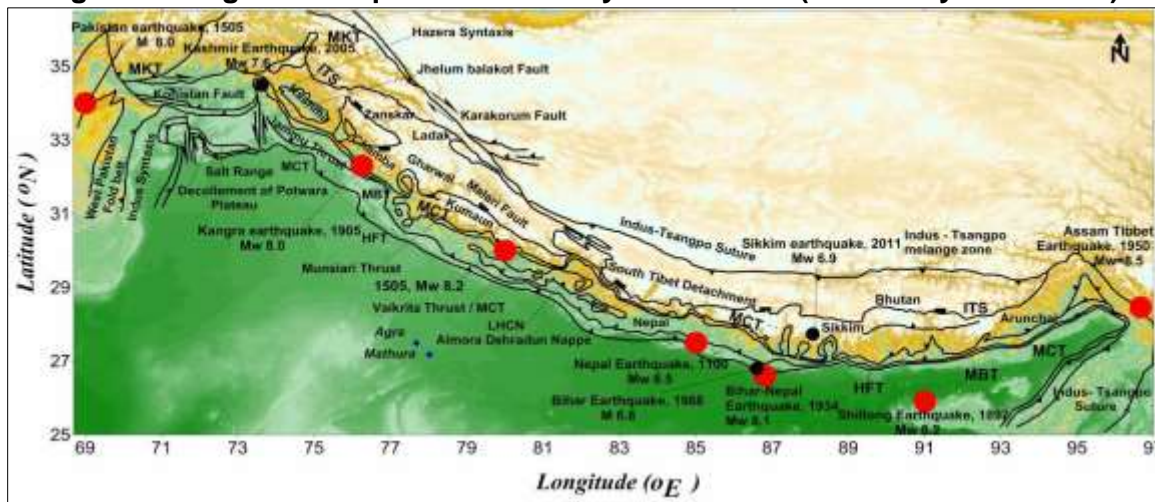
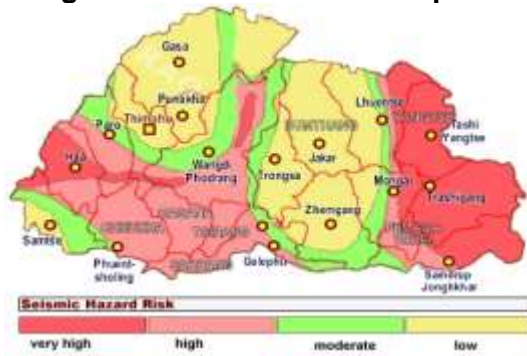


Figure 7: Largest earthquakes in Himalaya since 1900 (marked by red circles).



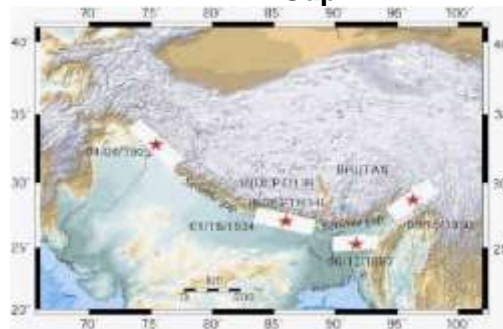
Source: Srivastava et al. 2013

Figure 8: Seismic Hazard Map of Bhutan



Source: IIT, Rourkee, 2009

Figure 9: Major Seismic Events and Bhutan Gap



Source: Tobgay, undated

45. Bumthang airport falls in the Thimphu formation of the Higher Himalayan Belt. This formation is made up of pre-Cambrian metamorphic garnets and schist and granite gneiss, and is a prominent geological formation in Bhutan.

46. Yongphula airport lies exactly on the boundary of Thimphu and Shumar formation. Shumar formation consists of metasedimentary rocks represented by phyllite, micaceous quartzite with rare limestone bands.

47. Gelephu airport falls in Quaternary formation of southern frontal belt borders with India in the south and comprises of boulder conglomerates, sand, silt and clay. Refer Figure 5 for geology of project area.

3. Seismicity

48. In general, Bhutan lies in a region with high to very high seismic hazard zone that increases toward the eastern parts of the country. Historically, earthquakes in the magnitude 5.0-6.0 range have been experienced and at least one magnitude 7.0 event is thought have occurred in the 1700's in eastern Bhutan and adjoining parts of India.(ASC 2009) However there is an absence of other large magnitude seismic events in Bhutan noted in the historical records. (Drukpa, et. al., undated) and a 'seismic gap' exists over the region of Bhutan in the large magnitude earthquake event sequence stretching from Nepal into Assam (see Figure 6, 7 and 8). This may be due to the uplift of the Shillong Plateau in Meghalaya state, north-eastern India, and relief of stress in boundary faults along the southern stretch of Bhutan. (Tobgay, undated) Still there is general agreement in the literature that Bhutan lays in a zone of high earthquake risk. Determining the seismic hazard zone is difficult due to lack of historical data; however if the seismic hazard zoning of similar areas in India is extended, Bhutan falls within seismic risk zones IV and V.

49. As per earthquake hazard zonation mapping carried out by the Indian Institute of Technology (IIT), Rourkee, 2009, Bhutan is divided into four hazard zones (very high, high, moderate and low). Bumthang airport falls under low earthquake hazard area. Gelephu and Yongphula airports lie in high and very high earth quake hazard zones respectively.

4. Hydrology, Surface water and Ground Water Quality

a. Hydrology

50. Bhutan has four major river systems: the Drangme Chhu; the Punatsang Chhu; the Wang Chhu and the Amo Chhu. Each flows swiftly out of the Himalayas, southerly through the Duars to join the Brahmaputra River in India. Figure 10 illustrates project locations in relation to major river system of Bhutan.

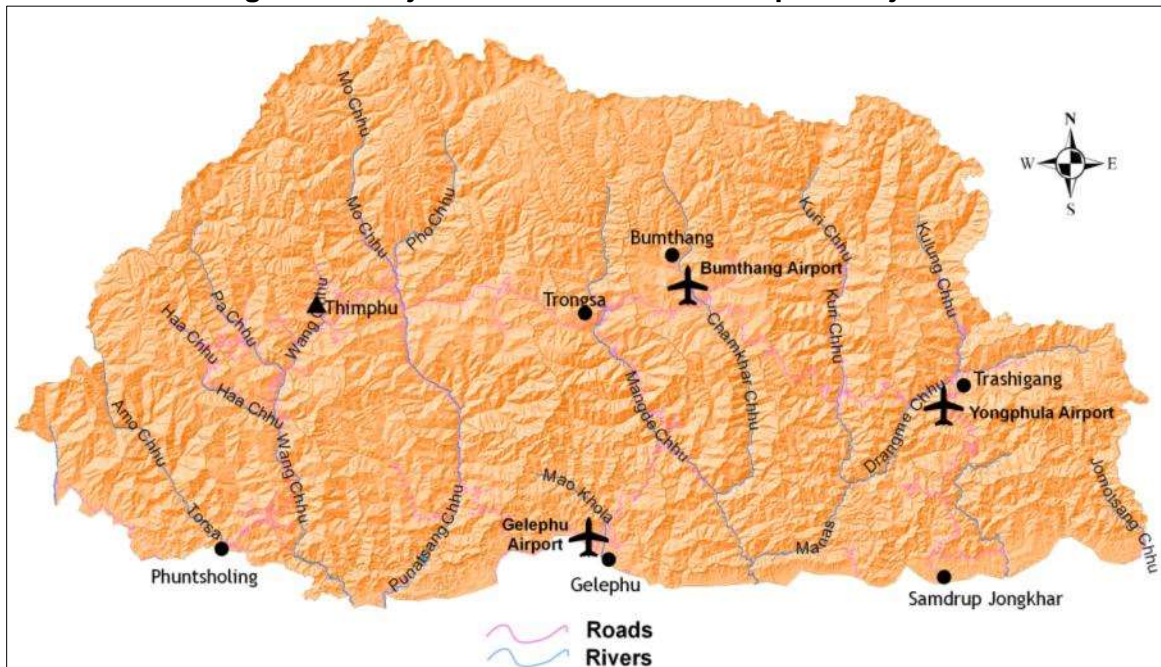
51. Chamkhar Chhu, which flow close to Bumthang airport, joins Mangde Chhu and Drangme Chhu to form Manas. The river originates from high glacial mountains, from the terrain south of the water divide (ridge) that separates Bhutan's northern territory from Tibet. Forty glacier lakes have been identified in the headwaters of the tributaries of Chamkar Chhu. The western tributary is fed by two fairly large glaciers (approx. 5762 meter amsl). The eastern tributary on the other hand has three glaciers named as Yakshing Glaciers which fed six glacier lakes (approx. 5340 amsl). The catchment area at

Kurjey is 1350 Km². Chamkar chhu nearby the project area has a flatter gradient forming few islands. River flow data of Chamkar Chhu measured at Kurjey, which is collated and analysed for two decades 1991-2010 shows that annual average flow has been 146.11 mcm in 1991 which has declined steadily in twenty years.

52. Drangme Chhu River falls within the 20 km radius of the Yongphula airport but there are no significant rivers or streams near the airport location.

53. Mao Khola and Bhur Khola are river systems that lie within 20 km radius of the Gelephu airport. However, the Paitha Khola and Aiepuwali Khola streams are the ones that actually traverse or intersect the airport. These streams are seasonal, flowing only during monsoon. During the field work of Gelephu airport in the month of August (peak monsoon season), the Paitha and Aiepulwali khola or streams were seen dry with only bare and exposed sand and gravel banks.

Figure 10: Major Rivers in relation to Airport Projects



b. Surface Water Quality

54. Water quality is the physical, chemical and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water.

55. Environmental water quality, also called ambient water quality, relates to water bodies such as lakes, rivers, and streams. Water quality standards for surface waters vary significantly due to different environmental conditions, ecosystems, and intended human uses. Toxic substances and high populations of certain microorganisms can present a health hazard for non-drinking purposes such as irrigation, swimming, fishing, rafting,

boating, and industrial uses. These conditions may also affect wildlife, which use the water for drinking or as a habitat. Modern water quality laws generally specify protection of fisheries and recreational use and require, as a minimum, retention of current quality standards.

56. Water samples have been collected at the southern end of the airport from Chamkhar Chhu River for Bumthang; pond water at Yonphula; and groundwater from Bore well at Gelephu airport. Water tests and laboratory analysis were carried out using state of the art laboratory system (Lamotte's Smart Water Quality Lab, USA). The results of water quality analysis are presented in table 4.

Table 4: Results of Water Quality Analysis

Parameters	Unit	Standard 2010, NEC (A)	WS1	WS2	WS3
Temperature	°C	-	3.8	5	5
pH		6.5-8.5	7.2	7.5	7.8
Turbidity	FAU	-	4	245	0
Color	CU	5	3	>1000	9
Smell		unobjectionable	unobjectionable	unobjectionable	unobjectionable
Copper	mg/l	0.05	0.08	0.25	2.43
Chlorine	mg/l	50	0	0.06	0
Chromium	mg/l	0.05	0	0	0
Iron	mg/l	-	0.08	>6.0	0.1
Phosphate	mg/l	0.5	0.05	0.45	0.03
Ammonia Nitrogen	mg/l	0.05	1.19	0.72	0.30
Silica	mg/l	-	>4.0	2.82	>4.0
Nitrate NO ₃	mg/l	10	0.12	0	0.19
Fluoride	mg/l	1	0	0	0
Sulphate	mg/l	25	10	6	5
Total Hardness	mg/l	-	58	0	20
Total Alkalinity	mg/l	-	38	10	20

Water quality sampling and analysis, December 2015. Note: WS1 – Chamkhar Chhu/River Water, WS2 – Pond Water at Yonphula, and WS3 – Groundwater from the Bore Well of Gelephu Airport

c. Ground Water Quality

57. There are no boreholes, wells or underground water tapping sites within Batpalathang or Chamkhar valley and Yonphula domestic airport project site.

58. The water for Gelephu airport is pumped from the underground source through bore well located at northwest of the runway. This ground water is used as drinking and for the fire services. The ground water quality has been tested by Public Health Laboratory of Gelephu Regional Hospital; and it is found to be fit for human consumption. The result of groundwater quality analysis carried out during PPTA study in December 2015 is provided in table 4.

d. Interpretation of water quality analysis results

59. Chamkar Chhu/River water quality in general is fairly good except for high ammonia content of 1.91mg/l against the acceptable standard of 0.05mg/l. The ammonia in river water could be as a result of dumping of waste water from various sources (cattle farms, hotel industries and the domestic sources in the upper region). The river water through conventional treatment of boiling and filtration could be used for drinking. It can be used for irrigation and other recreational activities without any treatment.

60. Pond water quality has markedly deteriorated from the pre-construction stage (2011) of ATCEP. The water quality is poor and unfit for human consumption and to be used any recreational activities due to extremely high turbidity.

61. The quality of ground water of Gelephu airport is very good with all the chemical contents within set national standards.

5. Ambient Air Quality

a. Purpose, and Location of Ambient Air Quality Monitoring

62. The purpose of the Ambient Air Quality Monitoring (AAQM) is to establish the ambient air quality baseline data for the project area prior to the implementation of the project; so that future air quality variation could be assessed during or after the project implementation. In other words, the existing quality of the air environment serves as an index for assessing the pollution load and the assimilative capacity of any region and forms an important tool for planning project activity in the area. The ambient air quality monitoring at BDA was carried out

b. Methodology for AAQM

63. The baseline air quality monitoring was done in line with the Strategy for Air Quality Assessment and Management in Bhutan 2010 of the NEC. For the measurement of particulate matters both the total suspended particulate matter (TSPM) and Respirable Particulate Matter (RPM) or Particulate Matter (PM10), a high volume sampler was used for 24 hours particulate monitoring for 2 consecutive days for one season (winter season from 16th – 18th December 2015). While for Nitrous oxides (NO_x), Sulphur dioxide (SO₂), and carbon monoxide (CO), the handheld multi-gas detectors were used to record the gas concentration on hourly basis for 8 hours for the same period as the particulate measurements studies.

c. Result and Interpretation of AAQM Monitoring

64. AAQM results for all project sites of winter season - TSPM, PM10, SO₂, NO_x and CO in microgram per cubic meter measurements are presented in the table 5.

Table 5: Baseline Ambient Air Quality

Airport	Parameter (measured in µg/m ³)				
	TSPM	PM10	SO _x	NO _x	CO
Bumthang	23.15	64.15	BDL	BDL	BDL
Yonphula	71.05	87.75	BDL	BDL	BDL
Gelephu	43.7	40.6	BDL	BDL	BDL

Source: Baseline Ambient air quality monitoring December 2015.

Note: BDL – Below Detection Limit.

65. TSPM and PM10 levels were below the National Ambient Air Quality Standard for mixed area provided in the Environmental Discharge Standard 2010, NEC. In the case of SO_x, NO_x and CO are not detected at all for the same location. The results of AAQM therefore indicate that existing ambient air qualities are good for all three sites.

Table 6: NEC's Ambient Air Quality Standards (Maximum Permissible Limits in µg/m³)

Parameter	Industrial Area	Mixed Area*	Sensitive Area**
Total Suspended Particulate Matter			
24 Hour Average	500	200	100
Yearly Average	360	140	70
Respirable Particulate Matter (PM 10)			
24 Hour Average	200	100	75
Yearly Average	120	60	50
Sulfur Dioxide			
24 Hour Average	120	80	30
Yearly Average	80	60	15
Nitrogen Oxides			
24 Hour Average	120	80	30
Yearly Average	80	60	15
Carbon Monoxide			
8 Hour Average	5000	2000	1000
1 hour Average	10000	4000	2000

* Mixed Area means area where residential, commercial or both activities take place,

** Sensitive Area means area where sensitive targets are in place like hospitals, schools, sensitive ecosystems.

6. Existing Noise Level

66. Unwanted noise and unpleasant sounds are generally classified as noise pollution. Normally a person begins to identify sounds when a level of 10 to 15 dB is reached. The other end of the scale is known as the threshold of pain (140 dB), or the point at which the average person experiences pain. Noise is generally measured in frequency-weighted scales and noise qualities measurements are generally represent in the 'A' level and reported as dB (A). The Sound Level Meter was used to monitor and record the ambient noise level at BDA for 24 hours period to understand night and Day time noise levels. Day time measurement was taken 6 A.M. to 9 P.M.; and from 10 P.M. to 5 A.M. was Night time measurement.

Table 7: Ambient Noise Level of three Project Sites

Airport	Ambient Noise Level (dBA)	
	Ld (Day)	Ln (Night)
Bumthang	55.58 dB(A)	54.77 dB(A)
Yonphula	55.24 dB(A)	43.85 dB(A)
Gelephu	52 dB(A)	45 dB(A)

Source: IEE Report 2012 and Ambient Noise Level Monitoring Survey December 2015

67. Average Noise levels for two consecutive 24 hours (Day and Night time) measurements for winter season for all three airport as illustrated in table 6 are well within the national limits for mixed area (Ld-65dBA and Ln-55dBA). Table 8 illustrates the Noise Level limits from the NEC's Environmental Discharge Standard 2010.

Table 8: Noise Level Limits, Environmental Discharge Standard 2010, NEC

Location	Day	Night
Industrial Area	75 dBA	65 dBA
Mixed Area	65 dBA	55 dBA
Sensitive Area	55 dBA	45 dBA

B. Biological Environment

1. Protected Area

68. The project areas do not fall within any protected areas or the biological corridors. Figure 10 illustrates the relative locations of these features with respect to project developments.

2. Forest Resources and Land Cover

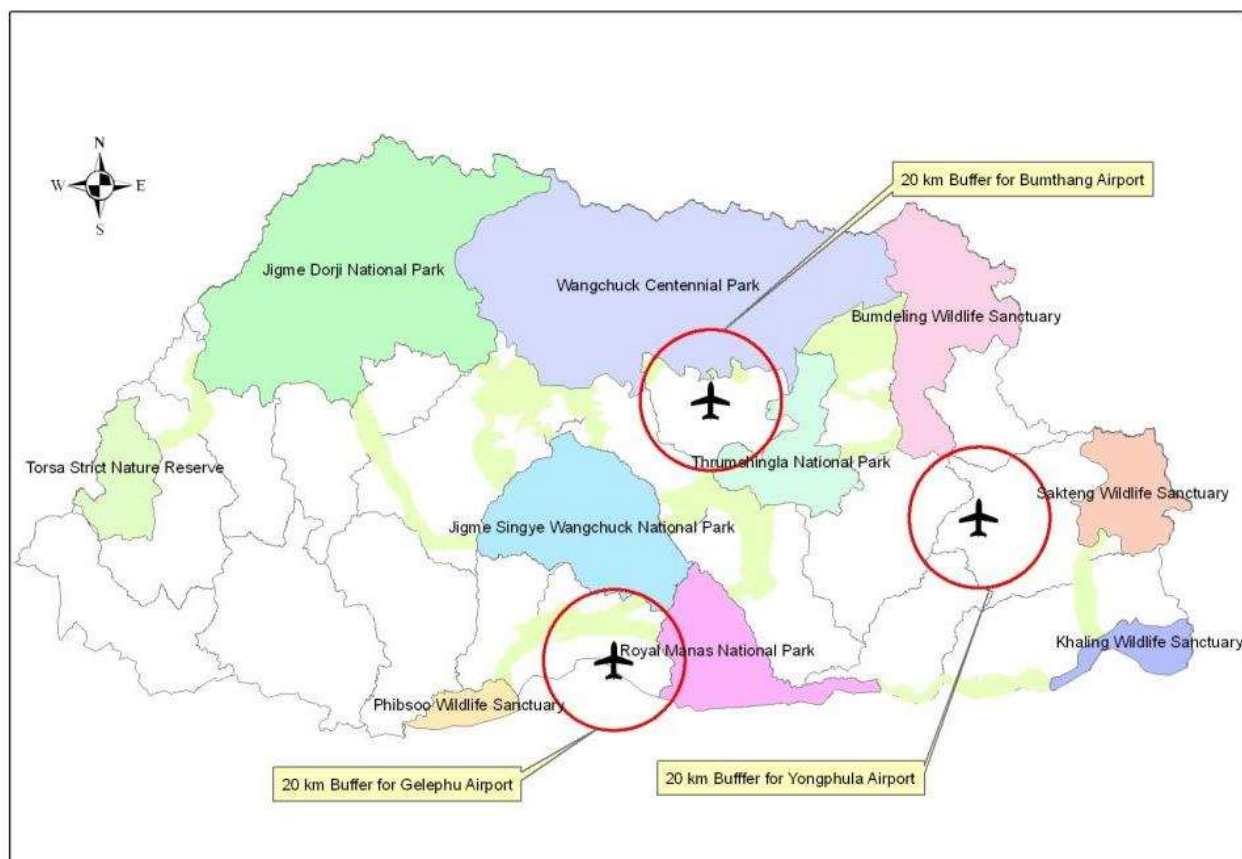
a. General

69. As per Land Cover and Area Statistic 1997 of MoAF, about 67% of the Bumthang, 66% of Trashigang and 82% of Sarpang Dzongkhag are under true forest cover. Trashigang has the highest percentage of agriculture land (14.2) followed by Sarpang (12%). Blue Pine Forests are dominant in Bumthang whereas Sarpang Dzongkhag has almost 100% broadleaf forest. The land cover details of the project affected dzongkhags are provided in Table 9.

Table 9: Land Cover figures of Bumthang, Trashigang and Sarpang Dzongkhags

Dzongkhag	Land Cover (Area in Ha)				
	Conifer Forest	Broadleaf Forest	Scrub Forest	Agriculture	Others (Snow, Glacier, Rock outcrop, Orchards etc.)
Bumthang	134,630.0	49.0	46,447.0	5,627.0	62,267.0
Trashigang	67,369.0	80,278.0	30,594.0	32,392.0	4,545.0
Sarpang	2,045.0	188,467.00	2,201.0	27,454.0	8,652.0
Total Area	204,044.0	268,794.0	79,242.0	65,473.0	75,464.0

Figure 11: Project locations and the protected areas of Bhutan



b. Land Use Change and Forest Loss

70. **Bumthang Airport:** Vacant flat land near the car park area is designated for the construction of a new airport terminal building. It is within the airport boundary, so no forest or agriculture land use conversion is required.

71. **Yongphula Airport:** There will be virtually no land use change due to the erection and low-level safety barrier around the runway of Yongphula Airport.

72. **Gelephu Airport:** Vacant land northwest of Gelephu Airport runway will be converted to built-up area – the construction of a security staff quarter. The area is within the airport boundary, and tree felling will be required.

c. Forest Types within the Project Sites

73. **Bumthang Airport:** There are no natural forests inside the airport area except for fodder trees, which are mainly willow trees planted by the National Feed and Fodder Development Programme. The proposed terminal construction site is totally flat and without any trees as it is completely within the airport boundary.

74. The forest in the immediate surroundings (on the slope towards the RNR RDC area) of the airport area is mainly blue pine forest with the characteristic floral species of *Pinus*

wallichiana, Berberis asiatica, Cotoneaster griffithii, Lyonia ovalifolia, Rhododendron arboretum, and Arisaema consanguineum.

75. Towards the northwest of the airport area, bordering the Chamkhar Chhu or River is the narrow band of riparian forest consisting mainly of Salix and Hippophae scrubs. Other main floral species found on the small river island are bamboos, Populus and Blue pine.

76. **Yongphula Airport:** The vegetation in the immediate surroundings of the airport is mostly scrub forest. On the eastern end of the airport, there are community forest and tree plantation carried out by the Department of Forest and Park Services. The lower on the altitude below 2000m towards Dangme Chhu valley is mostly warm broadleaved and on the drier slope are chir pine forests. On the higher slopes above 2000m is a cool broadleaved forests. The common tree species found in the cool broadleaved forest are Acer campbellii, Betula alnoides, Brassaiopsis alpine, Chirita lachenensis, Corylopsis himalayana, Elatostema monandrum, Exbucklandia populnea, Helwingia himalaica, Ilex fragilis, Lecanthus penduncularis, Lindera neesiana, Persea clarkeana, Pilea bracteosa, Rosa moschata, Rubus lineatus, Schisandra grandiflora, Symplocos dryophila. The construction of safety barriers along the edges of the airport will require no tree felling.

77. **Gelephu Airport** falls within subtropical forest which is largely deciduous with marked seasonal variation; dry winter season and wet summer (monsoon) season. The common species found in the project area are Acrocarpus fraxiniifolius, Ailanthus grandis, Bombax ceiba, Crateva religiosa, Dillenia pentagyna, Duabanga grandiflora, Gmelina arborea, Leea asiatica, Musa, Pandanus, Pterospermum acerifolium, Tetrameles nudiflora, Thunbergia. The proposed construction of security quarters will require only bush clearance as the area falls within airport boundary where trees already felled during airport construction.

d. Endangered and Protected Flora

78. No endangered or protected plant species as listed in Schedule I – Forest and Nature Conservation Rules of Bhutan, 2000 is observed or reported in all three project sites.

3. Mammals and Bird Life

79. Pine forests are rather extensive in and around the Bumthang airport area particularly the slope towards the Pedtsheling monastery. Since these forests are close to human habitation and prone to disturbances from fires, fuel wood and grass collection, wildlife abundance is low compared to other habitats. Nevertheless several species, including pheasants, partridges, common crow, magpie and mammals such as goral, Himalayan yellow marten are known to occupy these habitats. Table 8 provides the list of birds recorded during the field survey.

80. The wildlife habitat immediately around Yongphula airport is poor due to the proximity to human habitat. However, further away from the human habitation, the abundance of wildlife (mammals and birdlife) is evident. Mammals such as Assamese Macaque, wild boar, barking deer, goral, Himalayan Serow, Sambar, leopard etc. are known to inhabit the areas further away from the human habitation. Leopard is protected species under schedule I of Forest and Nature Conservation Act (FNCA) but it is

categorized as lower risk under IUCN categorization. The area outside the Yongphula airport is known to be good habitat for birdlife particularly because of the presence of the broadleaf forests. However, there are no reported endangered or threatened bird species in the area. The details bird species found in the area provided in the table 8.

81. The subtropical forest around Gelephu Airport area is known for the richness of wildlife both mammals and birdlife. Mammals such as elephant, barking deer, rhesus macaque, Bengal fox, hares, jungle cat etc inhabit the area. Elephant which known to occasionally visit the area is totally protected under Schedule I of FNCA and is categorized as endangered in IUCN red list. The sub-tropical forest along the foothills up to 1200m is the richest in bird species. The list of birds that are found the area is provided in the table 10.

Table 10: Avifauna recorded in Project Area

<i>Scientific name</i>	Common Name	B	Y	G	FNCA Status	IUCN Status
<i>Aceros nipalensis</i>	Rufous-necked hornbill			√	Protected	Vulnerable
<i>Buceros bicornis</i>	great hornbill			√	-	Near Threatened
<i>Pavo cristatus</i>	Indian peafowl			√	-	Least Concern
<i>Urocissa flavirostris</i>	Yellow-billed Blue Magpie	√	√		-	-
<i>Pica pica</i>	Black-billed Magpie	√			-	-
<i>Pyrrhocorax pyrrhocorax</i>	Yellow-billed Chough	√			-	-
<i>Nucifraga caryocatactes</i>	Spotted Nutcracker	√			-	-
<i>Corvus macrorhynchos</i>	Large-billed Crow	√	√	√	-	-
<i>Corvus splendens</i>	House Crow			√	-	-
<i>Lanius tephronotus</i>	Grey-backed Shrike	√			-	-
<i>Dendrocitta Formosae</i>	grey treepie		√	√	-	-
<i>Dendrocitta vagabunda</i>	rufous treepie			√	-	-
<i>Dicrurus macrocercus</i>	black drongo			√	-	-
<i>Streptopelia chinensis</i>	spotted dove			√	-	-
<i>Streptopelia orientalis</i>	oriental turtle dove	√	√	√	-	-
<i>Chalcophaps indica</i>	emerald dove			√	-	-
<i>Ducula badia</i>	mountain imperial pigeon		√	√	-	-
<i>Myophonus caeruleus</i>	blue whistling thrush	√	√	√	-	-
<i>Hypsipetes leucocephalus</i>	black bulbul	√	√		-	-
<i>Pycnonotus cafer</i>	red-vented bulbul		√	√	-	-
<i>Acridotheres tristis</i>	common myna			√	-	-
<i>Ictinaetus malayensis</i>	black eagle	√	√	√	-	-
<i>Spilornis cheela</i>	crested serpent eagle		√	√	-	-
<i>Celeus brachyurus</i>	rufous woodpecker		√	√	-	-
<i>Lanius cristatus</i>	brown shrike			√	-	-
<i>Megalaima australis</i>	blue-eared barbet			√	-	-
<i>Magalaima Virens</i>	great barbet		√	√	-	-
<i>Megalaima asistica</i>	blue -throated barbet		√	√	-	-
<i>Pericrocotus flammeus</i>	scarlet minivet	√	√		-	-
<i>Halcyon smyrnensis</i>	white-throated kingfisher		√	√	-	-
<i>Megaceryle lugubris</i>	crested kingfisher	√	√	√	-	-
<i>Chaimarrornis leucocephalus</i>	white-capped water redstart	√	√	√	-	-
<i>Enicurus schistaceus</i>	Slaty-backed forktail		√	√	-	-
<i>Copsychus saularis</i>	oriental magpie robin		√	√	-	-

<i>Scientific name</i>	Common Name	B	Y	G	FNCA Status	IUCN Status
<i>Heterophasia capistrata</i>	Rufous Sibia	√	√			
<i>Motacilla alba</i>	white wagtail	√	√	√	-	-
<i>Yuhina nigrimenta</i>	black-chinned yuhina		√	√	-	-
<i>Yuhina Zantholeuca</i>	white-bellied yuhina			√	-	-
<i>Garrulax albogularis</i>	White-throated Laughingthrush	√	√			
<i>Garrulax leucolophus</i>	white-crested laughingthrush		√	√	-	-
<i>Hirundo rustica</i>	barn swallow		√	√	-	-
<i>Phylloscopus trochiloides</i>	Greenish Warbler	√	√	√		
<i>Abroscopus superciliaris</i>	yellow-billied warbler			√	-	-
<i>Seicercus affinis</i>	white-spectacled warbler		√	√	-	-
<i>Cissa chinensis</i>	common green magpie			√	-	-
<i>Apus affinis</i>	house swift			√	-	-
<i>Collocalia brevirostris</i>	Himalayan swiftlet	√	√	√	-	-
<i>Tephrodornis gularis</i>	large wood shrike			√	-	-
<i>Oriolus traillii</i>	maroon oriole		√	√	-	-
<i>Hierococcyx sparverioides</i>	large hawk cuckoo	√	√	√	-	-
<i>Lophura leucomelanos</i>	kalij pheasants	√	√	√	-	-
<i>Gallus gallus</i>	red junglefowl			√	-	-
<i>Merops leschenaultia</i>	chestnut headed bee-eater		√	√	-	-
<i>Upupa epops</i>	common hoopoe	√	√	√	-	-
<i>Pomatorhinus erythrogegens</i>	rusty-cheeked scimitar babbler		√	√	-	-

Source: Field work December 2015

(Note: Project area B – Bumthang, Y – Yonphula, G – Gelephu)

C. Socio-economic Characteristics

1. Population and Poverty

82. The airport projects fall under of three dzongkhags namely, Bumthang, Trashigang and Sarpang. The total population of the three dzongkhags was enumerated in 2005 at about 106,448 persons with an overall average sex ratio (male/female) of 1.08. Within the geogs where airports are located there are about 29,910 persons. Population projections prepared for the dzongkhags by the National Statistics Bureau (NSB, 2008) show a rate of increase by 1.6% in 2015, reflecting overall population for the three dzongkhag by 2015 would be around 123,479.68. Number of households and population of administrative units within the three dzongkhags and affected geogs are shown in Table 11.

83. The Small Area Estimation of Poverty in Rural Bhutan, August 2010, jointly carried out by World Bank & NSB, shows the number of poor in the three dzongkhags to be 18,594 with the poverty rate of 15.5% for Bumthang, 30% for Trashigang and 23% for Sarpang. Poverty Analysis Report 2007 by NSB established the poverty line at Nu.1,096.94 per person per month.

84. About 22.18% people of the three dzongkhags lives in urban areas. Sarpang Dzongkhag has the highest number of people in the urban area with 12,596 (30% of the dzongkhag population). About 86% of the people of Trashigang live in rural areas. Hence there is high rate of poverty in Trashigang (30%) comparing to other two dzongkhags (15.5% for Bumthang and 23% for Sarpang).

Table 11: Population and Households of the Project Area

Dzongkhag ¹ and Geogs	No. of Geogs ² / Chiwogs ³ / Villages	No. of Households	Population as per PHCB 2005		
			Male	Female	Total
Bumthang Dzongkhag	Chhoekhor, Chhume, Tang and Ura geogs	2,870	8,751	7,365	16,116
Chhoekhor geog	5 chiwogs with 32 villages	798	2,509	2,044	4,553
Municipal Area	5 towns (Jakar, Bathpalathang, Chamkhar, Dekiling and Jalkhar towns)	740	2,350	1,850	4,200
Trashigang Dzongkhag	Bartsham, Bidung, Kanglung, Kangpar, Khaling, Lumang, Merag, Phongmed, Radi, Sagteng, Samkhar, Shongphoog, Thrimshing, Udorong and Yangnyer geogs	10,813	24,912	23,871	48,783
Kanglung Geog	5 chiwogs and 8 villages	1,064	2,419	2,330	4,749
Municipal Area	Kanglung town	278	976	741	1,717
Sarpang Dzongkhag	Chuzagang, Chudzom, Dekidling, Gakidling, Gelephu, Jigmichoeling, Samtenling, Serzhong, Shompangkha, Sengye, Tareything and Umling Geogs	8,211	21,664	19,885	41,549
Samtenling / Bhur	5 chiwogs and 8 villages	289	761	756	1,517
Gelephu	5 chiwogs and 7 villages	784	2,127	1,848	3,975
Gelephu Municipal	Gelephu town and the extended area	1,851	4,904	4,295	9,199

Source: Population & Housing Census of Bhutan 2005, Election Commission Delimitation Maps, 2011 and Field Survey 2015

2. Agriculture

85. In 2008, Agriculture contributed 18.5% to the total economy i.e. as measured by the Gross Domestic Product. It was also the single largest sector that provides livelihood to 66.6% of the population as per Bhutan Living Standard Survey (BLSS) 2007.

86. Only about 2% of the Bumthang Dzongkhag's total area of 2,714 km² is under agriculture, which is mainly found in the Chhume and the southern part of Chhoekhor geogs with predominantly the dry land farming. In recent years, paddy cultivation has been started in Chhoekhor geog. However, the main crops are wheat, buckwheat, barley and rye. Apart from the cereal crops, people of Bumthang cultivate potatoes and apples as the cash crops. About 8.2% of the total area of Bumthang Dzongkhag is Tsamdrol (pasture land) which carries more than 19,927 heads livestock (Livestock Population and Production 2010, Bumthang Dzongkhag).

87. Kamzhing (Dry land) is the dominant agricultural land use followed Chuzhing (irrigated wetland) under Trashigang. Maize, rice, wheat, millet, potato, garlic and chili are the main annual crops of the Dzongkhag. Apart from the agriculture, livestock rearing and poultry farming are also important activities. As per RNR census 2009, there are about 36,348 cattle, 1,019 pigs and 10,444 poultry.

¹ Dzongkhag - District

² Geog – Block (Administrative Unit under District)

³ Chiwog – Sub Block (Smallest Administrative Unit under Block)

Table 12: Agriculture Land Holdings and Land Types in the Project Area

Dzongkhag	Wetland (in Ha)	Dry land (in Ha)	Cash Crop Land (in Ha)	Total Area (in Ha)
Bumthang	65.53	4,120.70	42.87	4,229.10
Trashigang	1,097.59	5,717.45	77.87	6,892.91
Sarpang	1,902.90	4,181.22	1,349.53	7,433.65

Source: Policy and Planning Division, MoAF, Thimphu

88. Sarpang has highest wetland paddy cultivation with substantial yield 4.05 metric ton per hectare. Therefore, rice is important cereal produced in the area. The other important crops are maize, mustard and millet. The cash crops such as orange, cardamom, jackfruit, areca nut, ginger, guava and mango are grown. Sarpang has around 30,628 cattle, 1,264 pigs and 28,306 poultry (RNR census 2009).

3. Health

89. Overall for three dzongkhags (Bumthang, Trashigang & Sarpang), 17.8% of households have piped water inside the house, and 69.3% have piped water outside the house. Of the remaining, 12.9% of households utilize springs, rivers or ponds, and other sources. Overall there is a heavy reliance on piped water, totaling 80% (Population & Housing Census of Bhutan, 2005).

90. Concerning access to sanitation, among all dzongkhag, 9.44% of households have indoor flush toilets, and 60.33% utilize pit latrines. Of the remaining, 8.3% have no toilet facilities.

91. Some conclusions can be reached in respect to these data: there is little access to surface or groundwater and a heavy reliance on small, reticulated water supply systems (piped water). Use of some form of toilet facilities is high even in rural areas, compared to other parts of Asia. The values derived for dzongkhag regarding water supply and sanitation closely parallel those given in the 2005 census for urban and rural households, respectively, for the overall country.

92. The percent of households to visit health facilities in the past year for each of all three dzongkhag is close to the norm for the Country – about 90%.

4. Education

93. The average literacy nationwide is nearly 60%, and with the exception of Bumthang, other two dzongkhags have literacy rates lower than the national average. The lowest literacy rate is found in Trashigang dzongkhag, with 56.2%. All dzongkhags show literacy rates among the urban population higher than the national norm, and conversely literacy is particularly low among the rural population, with Trashigang the lowest at 52.3%.

94. Regarding school attendance, Trashigang dzongkhag also reflects the poorest ratio of attendance between male and female residents, with 27% of males having attended, and 19% of females. Corresponding values for Chhukha are 38% and 17%. Only 3.5% of urban residents in Trashigang dzongkhag have failed to attend school, whereas among rural residents, 51% have failed to attend. In Sarpang dzongkhag 10% of urban residents

have not attended school, and 38% of rural residents. These data indicate that the rural population is disadvantaged in education, and in some instances perhaps severely so.

95. The data for Trashigang and Sarpang dzongkhag bracket the range of education and literacy opportunity. No other data found in the 2005 census related to education can be readily disaggregated to reflect the situation within the project area.

5. Community Infrastructure

96. Community and rural infrastructure constructed by the Royal Government of Bhutan include community schools, primary schools (CPS), middle and high schools, hospitals, basic health units (BHUs), outreach clinics (ORC), renewable natural resources (RNR) extension offices and irrigation and rural water supply schemes (RWSS). Since the 8th Five Year Plan the government has begun construction of farm roads, power tiller tracks and mule tracks with the aim of connecting villages to market and administrative centers. The details of community infrastructures in the project area are provided in Table 13.

Table 13: Community Infrastructures in Project Affected Dzongkhag

S. No	Sector / Infrastructure	Bumthang Dzongkhag	Trashigang Dzongkhag	Sarpang Dzongkhag
1	RNR Sector			
a	RNR Center	6	17	5
c	Veterinary Hospital	1	-	-
e	Irrigation channels (Km.)	23.92	24.5	24.1
g	Farm roads (Km.)	89.2	182.9	89.1
2	Health			
a	Hospitals	1	3	2
b	Basic Health Units (BHU)	4	19	10
c	Out Reach Clinics (ORCs)	14	57	11
d	RWSS Construction (New)	185	68	
3	Education			
a	Higher Secondary School	2	3	4
b	Middle Secondary School	2	4	2
c	Lower Secondary School	3	9	4
d	Primary School	1	12	0
e	Community Primary School	12	35	11
g	Non-Formal Education Center (NFE)	18		
4	Roads and Bridges			
a	Suspension bridge	19	29	23
b	Motorable Bridge	-	-	-
5	Rural Electrification Coverage (%)			
a	No of Villages electrified	All 4 Geogs	13 Geogs	-
b	Percent of households electrified	100	91.19	-
6	Rural Telecommunication Coverage (%)			
a	No of villages covered	All 4 Geogs	15	-
b	Percent of households covered	100	96.39	-

Source: Midterm Review Document, 10th Five Year Plan, Statistical Year Book 2014 and Field Survey 2015.

D. Physical Cultural Resources

1. Religious, Historical, Cultural and Archeological Sites

97. There are no religious, historical, cultural and archeological sites within proposed project areas at Bumthang, Yonphula and Gelephu.

98. The religious and cultural entities such as Jakar dzong, Chakhar, Konchosum Lhakhang, Tamzhing Lhakhang, Padma Sambhava Lhakhang, Kurjey Lhakhang, Thangbi Lhakhang, Jampa Lkhkhang Chorten Lhakhang, Guru Lhakhang, Wangduchoeling Palace, Jakar Dzong, Lamey Gonpa, Jakar Lhakhang are located in Choekhor valley of Bumthang. Of the many monasteries and temples, Jambay and Kurjey Lhakhang are considered and revered as most sacred and holy temples in Bhutan and in the Buddhist world. Bumthang Airport is located 1.3 and 2.5 km southeast of these Jampa and Kurjey Lhakhangs. From the Jakar Dzong (District Administrative and Monastic center) it is located at around 1.15 km northeast.

99. In the immediate vicinity, on the eastern end of the runway of Yonphula airport is the Yulay Namgyal Chorten/stupa which has been relocated during the initial stage of ongoing ATCEP for the runway extension. Other important religious and cultural structure is Yonphula Lhakhang under Kanglung Geog which is located 2 km away from the airport. It is considered as the oldest temple in Trashigang whose establishment cannot be ascertained. It houses several sacred relics and a Tercham that is conducted twice in a year commemorates the feats of religious luminaries like Guru Padmasambhava.

100. Apart from few newly built monasteries or temples under Gelephu and Sarpang, there are no important historical, spiritual or cultural entities within the Dzongkhag. These structures are nowhere near to the Gelephu airport.

2. Visual Aesthetic, Recreational Resources and Tourism Potential

101. Bumthang dzongkhag consisting of four wide shaped valleys curved by ancient glaciers presents unique visual and aesthetic resources that are typical of the higher Himalayas. The area provides a diversity of potential recreational resources, natural beauty and scenic qualities, including hiking, trekking, river rafting, appreciation of nature, wild animals and forests, and access to secluded areas. In 2010, around 12,327 tourists arrived in the dzongkhag which is more than 20% increase from year 2010.

102. Trashigang is considered as the Jewel of the East. Trashigang spans the easternmost corners of the kingdom, skirting up to the edge of the Indian state of Arunachal Pradesh, and is the country's largest district. The district has an altitude ranging from 600 m to over 4000m and Bhutan's largest river, the Dangmechu, flows through the district. The beautiful valleys of Merak and Sakteng hosts Bhutan's last unspoilt bastion of traditional nomad yak herders. Once restricted area, the RGOB has recently allowed controlled tourism to encourage regional balanced development. In 2014, around 2,272 tourists arrived in the dzongkhag which is 41% increase from 2010 tourist arrival record.

103. Sarpang Dzongkhag is situated in the central southern foothills bordering India. The area of the dzongkhag stretches from Sunkosh, Lhamoizingkha in the west to the Royal Manas National Park in the east. It encompasses a total geographical area of

approximately 2,288 km² (Source- LUPP). Its topographic features have undulated terrain with an elevation ranging from 200m to 3600 m above mean sea level. About 82% of total land area is under forest cover. Due to its proximity to three protected areas; Royal Manas National Park in the east, Phibsoo Wildlife Sanctuary in the west and Jigme Singye Wangchuck National Park in the north, Sarpang Dzongkhag has considerable tourism potential particularly with regard to ecotourism. However, due to limited tourism infrastructure coupled with volatile security situation only about 179 tourists has visited Sarpang in 2014.

V. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

A. Introduction

104. This section provides an assessment of the positive and negative impacts on the physical environment in the immediate vicinity of the study area resulting from the development of the project, and the corresponding mitigation and enhancement measures to negate such adverse impacts. The environmental quality of the project site could be affected from project activities during each phase of project development, if environmental management measures are not properly followed.

105. This section discusses the potential environmental impacts of the proposed construction of new terminal building at BDA; and the construction of security quarter at GDA and identifies mitigation measures to minimize the impacts in the design or pre-construction, construction and operational phases.

106. As in all development activities, the construction works for BDA and GDA are likely to bring some kind of environmental impacts as a result of changes in bio-physical and socio-cultural environment. During the course of this Study, the environmental impacts have been identified for a number of issues based on the analysis of environmental baseline information and activities that are to be undertaken by the Project. Most of the identified impacts have been quantified to the extent possible on the basis of assessment of information collected from primary as well as secondary sources. Each of the environmental issues has been examined in terms of their current condition, likely impacts during construction and subsequent operation phases. The impacts have been predicted in terms of their magnitude, extent and duration. The predicted impacts are found to be insignificant as shown in the table 14.

Table 14: Predicted Adverse Impacts

Likely Impacts	Environmental Impacts				Significance
	Nature	Magnitude	Extent	Duration	
Construction Phase					
Impact due to Change in Land Use	Direct	Low	Site Specific	Short Term	Insignificant
Impact due to Earthwork Excavation and Disposal	Direct	Low	Site Specific	Long Term	Insignificant
Impact on Water Resources	Indirect	Low	Local	Long Term	Insignificant
Slope Instability and Erosion	Indirect	Low	Site Specific	Medium Term	Insignificant
Air and Noise Pollution	Direct	Low	Local	Short Term	Insignificant
Water Pollution	Direct	Low	Local	Short Term	Insignificant
Loss of Forest	Direct	Low	Local	Short Term	Significant
Pressure on Forest Product	Indirect	Medium	Local	Long Term	Insignificant
Disturbances on Wildlife	Indirect	Low	Local	Short Term	Insignificant
Pressure on Social Service and Facilities	Indirect	Medium	Local	Short Term	Insignificant
Occupational Health and Safety	Direct	High	Site Specific	Short Term	Insignificant
Health and Sanitation	In direct	Medium	Local	Short Term	Insignificant
Impact on Local Culture	Indirect	Low	Local	Short Term	
Operation Stage					
Soil Stability and	Direct	Medium	Site	Long Term	Insignificant

Likely Impacts	Environmental Impacts				Significance
	Nature	Magnitude	Extent	Duration	
Management			Specific		
Air and Noise Pollution	Direct	Medium	Local	Long Term	Insignificant
Water Pollution	Indirect	Low	Local	Long Term	Insignificant
Road Safety Measures	Direct	High	Local	Long Term	Insignificant
Socio-economic and Other Issues	Indirect	Low	Local	Medium	Insignificant

B. Adverse Impacts during Construction Phase

1. Impact due to change in Land use

107. Impacts due to Land use change will be negligible as the proposed sites for new airport terminal building at Bumthang and a security quarter at Gelephu are to be constructed on planned and designated areas which are free of any structures or natural vegetation. Construction of safety barrier at Yonphula airport will have no impact on the existing land use pattern.

108. **Mitigation Measures:**

- Constructions of airport terminal building of Bumthang and security quarter of Gelephu airport shall be carried out as per approved plan and design; and within the respective airport property boundary.
- Constructions safety barrier shall follow the design and will not encroach into the private land or the government reserved land.

2. Impact due to Earthwork, Excavation and Disposal

109. The construction of new terminal building and security quarters at Bumthang, and Gelephu airports respectively will require minimal excavation, filling and leveling of earth as the proposed both the construction sites on a flat land. Similarly, the construction of low level safety barrier around Yonphula airport runway will require virtually no excavation, filling or leveling. Whatever little amount excavated material generated from construction sites in all three airports can be easily used within airport for leveling of the undulated surfaces without a need to look for dumping site.

110. Despite minimal earthworks in all three project sites, there can still be some impacts resulting from the construction activities which will be related to erosion of top soil, loosening of soil compaction material, dust pollution and siltation of river and streams. These impacts will be insignificant if following mitigation measures are employed.

111. **Mitigation Measures:** Haphazardly dumped excavated material will likely cause soil erosion during rainy season and generate dust related pollution during dry windy seasons. Following mitigation measures shall be employed by the contractor to avoid, reduce or minimize the impact of dust pollution and erosion.

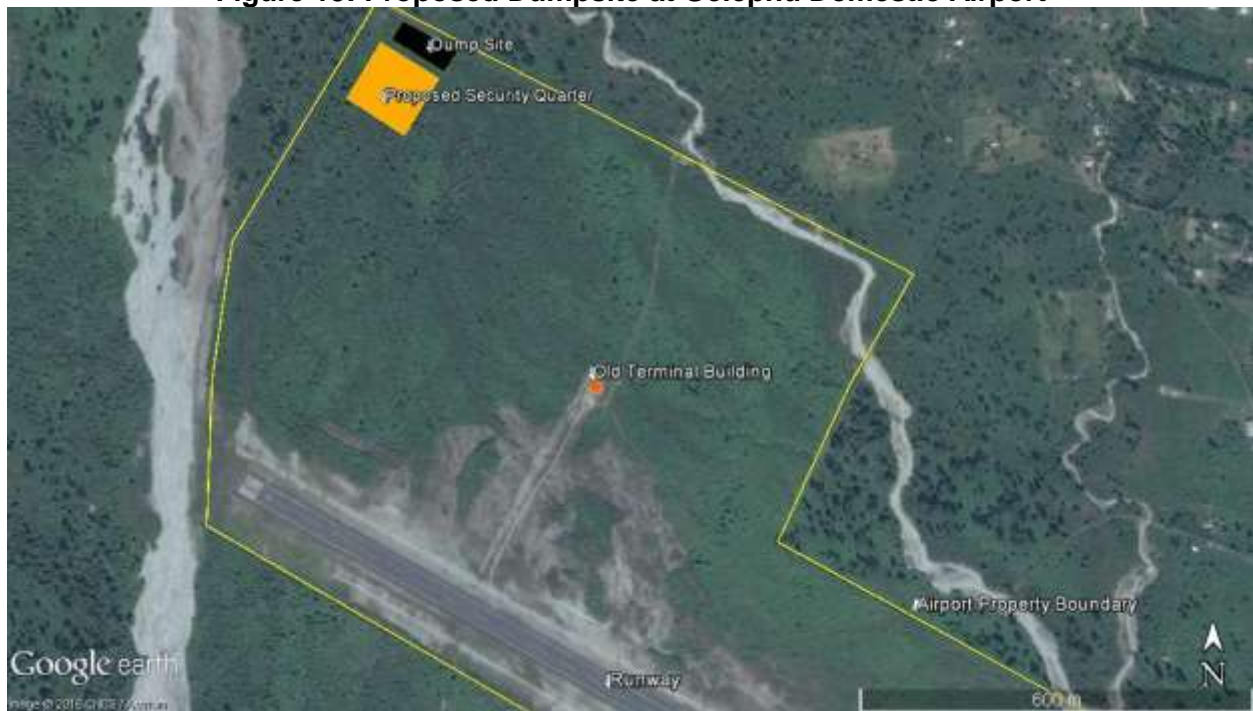
- All excavated material from the construction sites of Bumthang and Gelephu airport shall be disposed off properly at the designated site shown in figure 12 and Figure 13 respectively.
- There will be minimal excavated material from low safety barrier construction of Yonphula airport. It shall be properly disposed in the

immediate vicinity of safety barrier construction zone itself. It is strictly prohibited to dispose the spoil into the stream channels to prevent erosion and siltation downstream.

Figure 12: Proposed Dumpsite at Bumthang Domestic Airport



Figure 13: Proposed Dumpsite at Gelephu Domestic Airport



112. **Construction Material and its Transportation:** The construction materials such as stone and sand will be sourced from an area outside the construction zones. The stones or boulders for making aggregate for construction of new airport terminal building at Bumthang airport will be brought from Gathak Quarry located some 32 km from the airport. The Gathak Quarry is approved by the Department of Geology & Mines (DGM) and the quarrying is carried out as per DGM's quarry and mining rules. Transportation of stones from the quarry till the Bumthang airport site will pass through number of settlements (Tangsibi, Jalkhar, Chamkhar and Bathpalathang).

113. Construction of security quarter like any other residential building will require bricks, cement, sand, steel etc. The cement, sand, stones and steel can be sourced from within Bhutan while bricks and other construction items will be imported.

114. Haphazard quarrying will cause severe environmental damages such as slope failure, soil erosion, surface water pollution and siltation downstream. The haulage of construction materials from the quarry to construction sites increases the pollution due to vehicular exhaust and to dust from exposed construction materials.

115. **Mitigation Measures:**

- For construction material such as stone, aggregates and sand for construction new terminal building shall be sourced from RGOB/NEC approved quarries under Bumthang Dzongkhag. Gathak quarry at Bumthang is one such quarry that supplies stones and aggregates required for construction. This quarry is operated legally and environmentally friendly manner.
- The stones and sand for the construction of security quarter at Gelephu airport will be sourced from the NRDCL operated stone and sand quarries under Sarpang Dzongkhag.
- Contractor shall mandate their construction material transporter to comply good practices of material transportation. All vehicles carrying hazardous, dust generating construction material shall be properly covered during transportation to minimize dust pollution.
- All access roads wherever there are possibilities of generating dust pollution which is within the Contractors jurisdiction shall be sprayed at least twice a day to minimize dust pollution.
- Contractor shall demand the transporters to carry out vehicular test to check the exhaust pollution limit of vehicles transporting materials to the construction site if the construction materials are transported by the third party. If the contractors use their own vehicles, then the regular maintenance of transport vehicles shall be carried out to reduce the exhaust fume pollution.

3. Seismicity

116. Overall, Bhutan falls under seismic zone IV and V which is high risk zone and the risk of earthquake is ever-present in Bhutan. Seismic events may cause damage to the structures and adjacent property, and result in loss of life.

117. **Mitigation Measure:**

- Earthquake risk has been incorporated into the detailed design of structures.

- For analysis, design and detailing of structures or building, following codes from Bhutan Building Rules 2002 shall be applied;
 - For analysis of structure code 9.2.2 IS 1893 - 1984: Criteria for earthquake resistant design of structures
 - For design of structure, code 9.3.2 IS 4326 – Earthquake resistant design & construction of building
 - For detailing of structure, code 9.4.2 IS 13920 –1993: Ductile detailing of concrete structures subjected to seismic forces

4. Water Environment (Surface and groundwater resources)

118. During construction surface and ground water resources may be affected by accidental spillage or by inappropriate management practices of hazardous substances into a river or streams and ground water channel. Constructions of terminal building at Bumthang; and construction of security staff quarters will have minimum impact on water resources. But nonetheless, accidental and deliberate spillage of construction waste may pollute surface water (Chamkhar Chhu/River) and ground water resources (at Gelephu). No impact on water resources from erection of safety barrier at YDA. However, the impact on water resources of BDA and GDA could be avoided if the following mitigation measures are implemented:

119. **Mitigation Measures:**

- Discharge of sediment laden construction water (e.g. from areas containing dredged spoil or pumped ground water from building foundations) directly into surface water courses will be forbidden. The sediment laden construction water will be discharged into settling ponds or tanks prior to final discharge. This applies particularly to the Bumthang and Gelephu airports construction works along the river/stream banks.
- Washing of vehicles or any construction equipment in the Chamkhar Chhu River or any other stream shall be strictly forbidden.
- Wastewater/sewage and hazardous waste will not be dumped directly into the ground to avoid ground water pollution. In the case of construction of pit latrine, all five sides will be properly lined with cement to prevent leakage of untreated sewage and wastewater into the underground water source. This is applicable to Gelephu construction site.
- Storm water will be equally diverted towards the western side of runway to reduce the volume of the flow and further erosion downstream.

5. Construction and other Wastes

120. **Solid waste:** During construction, construction wastes or domestic waste/garbage will be generated which if not managed will pollute land and water bodies. The solid waste could be categorized into hazardous and non-hazardous or organic (biodegradable) and inorganic (non-biodegradable).

121. The amount of construction waste generated by project is difficult to be estimated. Therefore, estimation is only provided for the domestic wastes generated from the construction camps. It is estimated to be around 0.42kg (dry weight) per person per day. The table 15 shows estimated amount of garbage that will be generated by labourers employed by the respective project sites.

Table 15: Estimation of Solid Waste generation by the project

Garbage generated	Per day in kg	Per month in kg	Per year in kg
Per person	0.42	12.6	151.2
20 Labourers at BDA	8.4	252	3,024
20 Labourers at GDA	8.4	252	3,024

122. Mitigation Measures:

- The construction workers shall be directed to sort their garbage into biodegradable and non-biodegradable. The biodegradable garbage shall be disposed off in a suitable landfill site or garbage pits.
- For every campsite, the contractor shall construct garbage pits.
- After the completion of garbage disposal, the garbage pit will be decommissioned by covering with the soil and compact it to prevent leakage.
- The non-biodegradable wastes like plastic bottle/paper/metallic wastes shall be collected and given to authorized scrap dealers for recycling.
- Hazardous waste such as spent batteries, acidic substances and used fuels shall be properly stored and sent for recycling

123. **Sewage and wastewater:** Dumping of wastewater and sewage generated from the construction camps can pollute local water resources and causes water borne diseases. According WHO, the average wastewater generated by a single person is about 50litres per day. BDA and GDA will have minimum of 20 construction workers each and will generate roughly around 2750 litres of wastewater daily.

124. Mitigation Measures:

- Ordinary pit toilets shall be constructed at BDA for sewage/wastewater treatment.
- Especially cement lined or sealed pit toilet shall be constructed at GDA workers campsite to prevent leakage and contamination of ground water. For Gelephu airport, the groundwater is used for drinking and other purposes.
- Pit toilets once completed their usage shall be decommissioned by covering with soil and compacting it to prevent leakage of wastewater into surrounding environment.

6. Air Environment

125. During site clearance and earthwork there will be a temporary adverse impact on air quality in terms of increased dust suspension and gaseous emissions from the movement of vehicles and construction equipment. Dust will inevitably occur at and inside the construction sites throughout that period. During construction, dust will also be generated alongside the haul routes while transporting construction materials. In addition dust will be a health and safety issue for the workforce at the site.

126. Mitigation Measures:

- Regular spraying of the work area and haulage routes. River water from Chamkhar chhu could be used for spraying the work area at BDA; and Gelephu airport's ground water from its bore well could be used for dust suppression at GDA.

- Covering the construction material during transportation;
- Timely and regular maintenance of construction equipment and machineries to reduce gaseous emissions;
- Provision for gas/facemasks for construction workers to prevent direct inhalation of dust

7. Noise Environment

127. Construction zones at BDA, YDA and GDA are at least 350m, 300m and 600m respectively from the nearest human settlement. Since the scale of construction is small, issue of noise pollution will be limited to the construction site only. Therefore construction noise may only impact the labourers working for the project. The level of noise exposure and associated risks for the health and wellbeing of the workforce depends on the individual work place and type of equipment used.

128. **Mitigation Measures:**

- Limit the working period to daylight hours (8am - 5.30pm).
- The potential negative impact of construction noise on the workforce will be generally mitigated by providing the workforce with appropriate noise protection gear such as earplugs and by using construction equipment that produces less noise.

8. Ecological Environment

129. **Loss of vegetation due to site clearance:** All three proposed sub-project sites at BDA, YDA and GDA are devoid any natural cover or any standing trees that need to be felled. There will be no loss of forest cover due to site clearance and hence no mitigation measures are recommended.

130. **Pressure on forest product:** Since the scales of construction activities are small, the requirements for construction workers are estimated to be 20, 15 and 20 personnel for BDA, YDA and GDA respectively. Consequently, the pressure on forest product for fuel wood for cooking and heating will be not very significant. The overall impacts under this category will be insignificant. Nonetheless following measures shall be applied to avoid any competition to local resources:

131. **Mitigation Measures:**

- Contractor shall provide cooking fuel either Liquefied Petroleum Gas (LPG) or fuel wood from legal supplier.
- Timely wage payment for labourers to buy food stuff so that they don't resort to foraging of forest products in competition to local population.

132. **Impact on wildlife and habitats:** Since the proposed construction activities: building of new terminal building at BDA; erection of low level safety barrier at YDA; and construction of security staff quarters at GDA are all within the respective boundaries, there will be no direct impacts on wildlife and the habitats. Nonetheless, some impacts on wildlife are being anticipated such as illegal fishing in Chamkhar Chhu, Bumthang; and illegal hunting and trapping of wildlife at Yonphula and Gelephu by the construction workers. To prevent these impacts following measures shall be adopted.

133. **Mitigation Measures:**

- During the construction period, PCU/Contractor in coordination with DFO will organize special instruction and awareness raising training for the workforces to deter illegal fishing, hunting or trapping of wildlife.
- Forest officials of respective project sites shall make a surprise visit to campsite and other work areas to discourage the workers from illegal activities.
- Contractor shall be held accountable for any illegal activities that are carried out by its workforce.

9. Socioeconomic and Cultural Environment

134. **Land acquisition and resettlement.** The project will not require any private land acquisition or demolition of standing structures as the construction works will be restricted within the DoAT's property boundaries of BDA, YDA and GDA. Hence there will be no resettlement issues for the project sites.

135. **Community infrastructures.** There are no community infrastructure within or in the vicinity of the Project sites of BDA, YDA and GDA. Hence no impacts are anticipated.

136. **Occupational Health, Safety and Wellbeing of construction workers.** During construction the health and safety of the workforce will be at risk from accidents, long shifts and through accommodation at a campsite. To minimize the risks associated with these conditions DoAT will be responsible to ensure that adequate health care arrangements will be available at the site throughout the construction period.

137. **Mitigation Measures:**

- The construction workers will be provided with adequate and appropriate shelters which are wind and rainproof. The camps will be constructed at safe distance from the habitation of the local communities to minimize the disturbances or undue interference by the foreign workers.
- Access to healthcare will be ensured with provision of first aid at the work sites. And in the event of major accidents, emergency services of the district hospitals of Bumthang, Trashigang and Gelephu shall be availed.
- Adequate water supply, pit toilets and solid waste disposal sites will be provided
- Monitoring of the sanitary conditions within the worker's camps is the responsibility of the respective Project Coordinators of BDA, YDA and GDA as well as by the construction supervision consultant, who would regularly carry out surprise checks to inspect the camps.
- For wellbeing of labourers, the regional labour officer from the Ministry of Labour and Human Resources (MOLHR) shall make frequent and surprise check on the compliance of occupational health and safety.

138. **Communicable Diseases (HIV/AIDS/Tuberculosis), and Human Trafficking.** During construction phase, the project may employ local communities and also import number of skilled/semi-skilled foreign labourers for the construction works. The import and presence of large number of foreign workers increase the chances of spread of communicable diseases such as HIV/AIDS, tuberculosis etc. RGOB makes it mandatory for the foreign workforces undergo compulsory test for HIV/AIDS and communicable diseases. Only those who are free of diseases are awarded work permit.

139. **Mitigation Measures:**

- To minimize the risk of spread of the communicable diseases, the contractors and their workforces shall be made aware of the danger of diseases through educational campaigns. For example, Health Information and Service Center (HISC) or Dzongkhag Health Sectors in the respective project areas of Bumthang, Yonphula and Gelephu shall be invited to provide awareness education on sexually transmitted and other communicable diseases.

C. Adverse Impacts during Operation Phase**1. Air and Noise Environment**

140. Due to larger airport terminal building and other improved facilities at the airports of BDA, YDA and GDA will facilitate the increased number of aircraft operations. These will inevitably lead to some increase in air and noise pollution. However, the air and noise pollution will not be severe as the number of traffic mostly limited thrice a week only. Air traffic is likely to remain low for foreseeable future. Despite the negligible impact on ambient air and noise environment, following measures will be implemented during operational period:

141. **Mitigation Measures:** The other major pollutants found to be generated in an airport is from the aircraft exhaust. Hence, following methods of abatement can be adopted to control the air pollution at the source level:

- Shut down of engines to the maximum extent possible during taxiing and idling period.
- Allowing aircrafts with ICAO certified engines to land and takeoff, as far possible

142. The ICAO Balanced Approach⁴ concept provides airports with an agreed methodology to be used to address and manage aircraft noise problems in an environmentally responsive and economically responsible way. The Balanced Approach to noise management encompasses four principal elements:

- Reduction of noise at source;
- Land use planning and management;
- Noise abatement operational procedures;
- Operating restrictions on aircraft.

2. Waste Management

143. **Solid waste.** During operation, it is estimated that there will be two flights per week to all three domestic airports. Every week each airport will handle roughly around 80 people which is inclusive of airport staff, crew and passengers. The estimated solid waste generation is roughly around 252kg per week and monthly around 1000kg.

144. **Mitigation Measures:**

⁴ See: ICAO Airport Development Reference Manual, 9th edition, 2004

- The airport management shall sort their garbage into biodegradable and non-biodegradable. The biodegradable garbage shall be disposed off in suitable landfill sites of respective municipalities.
- The non-biodegradable wastes like plastic bottle/paper/metallic wastes shall be collected and given to authorized scrap dealers for recycling.
- Hazardous waste such as spent batteries, acidic substances and used fuels shall be properly stored and sent for recycling to India.

145. **Sewage and Wastewater.** Dumping of wastewater and sewage generated from the airport operation can pollute local water resources and causes water borne diseases. According WHO, the average wastewater generated by a single person is about 50litres per day. Each project sites at BDA, YDA and GDA will have minimum of 80 people using the respective airport and will generate roughly around 4000 litres of wastewater weekly.

146. **Mitigation Measures:**

- BDA and GDA shall construct septic tanks and soak pit to treat wastewater and sewage generated from the new terminal building and security staff quarters respectively to prevent contamination of ground and surface water.
- Septic tanks and soak pits shall be replaced with more advance wastewater treatment plant (eg. with Sequential Batch Reactor Plant) in future as the amount of wastewater generation increases beyond the capacity for septic tanks and soak pits to handle.

D. Cumulative and Induced Impacts

1. Introduction

147. Domestic airports construction by the RGOB from 2010-2011; and subsequent improvement of the same airports through ADB grant project (ATCEP which is ongoing) was the biggest air transport projects ever undertaken by the RGOB in the central, eastern and southern region. With the additional finance from ADB, the RGOB plans to consolidate and further improve the three airports. The cumulative impact from the additional finance is expected to be none as the overall scope of proposed ATCEP-AF is very small. However, there will be some induced impact as a result of the implementation of the Project.

2. Induced Development and Impacts

a) Positive Socioeconomic Impacts

148. The overall of objective of the RGOB is to diversify the economic base and to achieve balanced growth and sustainable development by promoting agriculture, industry and tourism.

149. The tourism in particular has an outstanding potential and could be developed to become the greatest foreign exchange earner of the country. The new airports will contribute to overcome the main obstacle for future economic development provision improved accessibilities. Therefore the positive impacts will be complex and nationwide. The most important positive impacts are socioeconomic and spatial development effects.

150. The establishment of airports is expected to create scores of new jobs, which will add to the locally growing demand for housing, shopping and other commercial activities in Bumthang, Yongphula and Gelephu areas. Thus the new airport is expected to contribute considerably to future economic growth and public welfare.

b) Impacts on Traffic Volumes, Patterns and Safety

151. Looking at the geographical location of the domestic airports with existing commercial, residential and tourist centres in Bumthang and Trashigang, it becomes obvious that most of the users of the new airport will be using the narrow access road to the airports. There will be congestion and traffic safety problem as a result of increased traffic. This effect will be temporary and can be mitigated with improvement of access roads.

152. The expected local and regional development and growth together with growing traffic volumes and changes of traffic patterns will not only have spatial planning implications but also increase the demand for the provision of upgraded and / or technical, transport and social infrastructure. Therefore, the DCA along with the respective Dzongkhags, Geogs and municipal administrations will prepare development or zoning plans in the immediate vicinity of the airports. These plans shall be in line with the overall national plan so that they are holistic in nature contributing to socio-economic wellbeing and happiness of the people.

c) Impact of Tourism

153. It is assumed that the new domestic airports will generally give further impetus to the development of the tourism sector of the country. The related infrastructure development is expected to follow in the central, southern and eastern region of the country. The development of tourism and related infrastructures will bring in unplanned development, encroachment into sensitive or critical wildlife areas and social and cultural erosion. However, by following the principle of low volume and value tourism policy, the impact of tourism will be minimal and manageable. In fact, responsibly managed tourism will have positive impact on the environment.

d) Impact on Real Estate

154. The public sector infrastructure projects as mentioned earlier and resulting induced development will generally result in increased pressure for new land to be developed in the central, southern and eastern regions of the country. In the medium to longer term expanded economic activities will create substantial demands for the full range of public and private services and especially for land to be developed with housing, work places, commercial establishments, schools, parks etc.

155. The demand is likely to rise in the near future and the scale and pace of demand for new development is expected to accelerate as the Project takes shape. As the value of the land in that part of the country will increase, speculations will inevitably occur and induce conflicting and most likely unsustainable demands. The signs of such demands for new development have already been observed during the public consultations at all three domestic airport sites.

E. Climate Change Vulnerability Assessment

156. The projected climate change in the project areas were assessed using an ensemble of 18 global climate models of the Climate Wizard as follow:

- Bjerknes Center for Climate Research, University of Bergen, Norway BCCR-BCM2.01
- Third generation Canadian Centre for Climate Modelling and Analysis CGCM3.1 model
- Centre National de Recherches Meteorologique Coupled Global Model, CNRM-CM3
- Climate Model Center for Australian Weather and Climate Research, CSIRO-MK3-0.1
- Geophysical Fluid Dynamics Laboratory Coupled Models 2.0 and 3.0, GFDL
- Institute of Numerical Mathematics, Russia Academy of Science INMCM3.01
- Institute Pierre Simon Laplace (IPSL) Climate Model (France). IPSL-CM4
- Center for Climate System (Japan). MIROC3.2 (Mendez)
- Meteorological Institute of the University of Bonn (Germany / Korea). MIUB-ECHO.G
- Max Planck Institute for Meteorology (Germany). ECHAM5/MPI-OM
- Meteorological Research Institute (Japan). MRI-CGM2.3.2
- National Center for Atmospheric Research Community Climate System Model. ACAR-CCM3.1
- National Center for Atmospheric Research Parallel Climate Model 1.1
- Handley Center for Climate Prediction and Research. UK Met Office UKMO-HACCM3.1

157. Simulated Projection on Temperature and Precipitation. Using an ensemble of global climate models (see succeeding Figures) the following climate change projections are made:

- Towards the 2050s using IPCC SRES A2B emission scenario, Bumthang, Yongphula, and Gelephu will experience an increase in annual average temperature from a low of 1.4 oC in Yongphula to a high of 3.4oC in Bumthang with an average increase of about 2.2oC. For the entire country, months of February and April will experience the largest departure from monthly historical records reaching as high as 6oC increase.
- In terms of annual average precipitation, the ensemble all three airports will experience a slight increase of around 12 mm. For the entire country, the largest decrease in historical monthly precipitation records occurs between the months of January and February with an average of -24 mm while the largest increase May, June, and July with an average of 129 mm.

158. Potentials Impacts of Increase in Temperature and Marginal Increase in Rainfall. An increase in the annual average temperature of 3oC is may not be significant to affect the operation of the domestic airports. A projected 6oC increase in the average temperature from 1960-1990 can increase the temperature from 13oC to as high as 19oC between the months of February and March. These temperature levels are not enough to cause pavement buckling, premature fleet and tire weathering and therefore the existing

choice of construction materials and engineering design are robust. However, at these temperatures operation cost of the domestic airports may be affected in terms of:

- more hot days and increase in moisture particularly on high elevation airports can reduce airplane performance which could result to reduce payload; and use of greater thrust leading to more fuel consumption, increase in greenhouse gas emissions, and noise;
- Increase use of utility system for air conditioning will increase electricity consumption and decrease life of equipment.
- Limitation of outdoor maintenance and services resulting to increase risk in morbidity from workers or increase need for labor

159. The most significant risk from the projected increase in temperature is the Glacial Lake Outburst Flood (GLOF). As mentioned in the IEE report, the Chamkhar Chhu, which flow close to Bumthang airport, originates from the glacial lakes. Bumthang Airport is zoned by the government as hazardous to flooding where in May 2009 cyclone Ayla in caused extensive damages to the infrastructural properties throughout Bhutan including Bumthang. To address this risk the Department of Air Transport (DOAT) implemented reclamation, diversion, river training and protection works on Chamkhar Chhu under the first RGOB financed project.

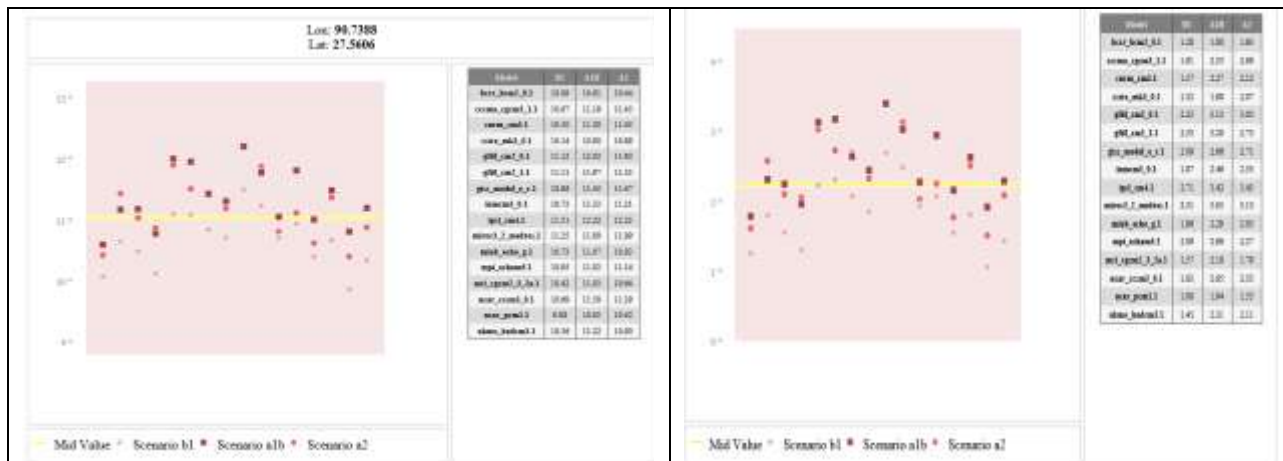
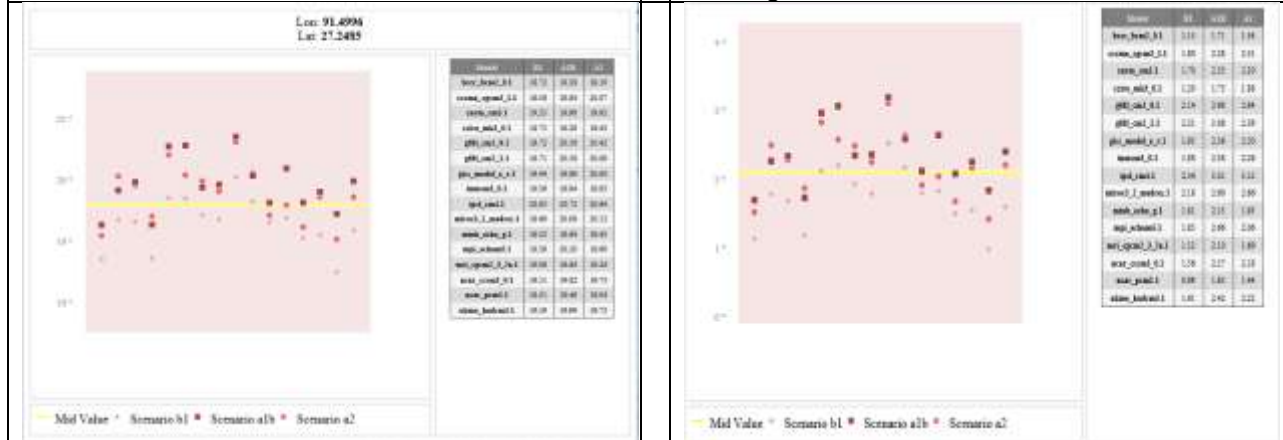


Figure 1. Bumthang Airport Average Annual Temperature by 2050s, Ensemble Average, SRES Emission Scenario A2

Figure 2. Bumthang Airport Change in Annual Temperature by 2050s, Ensemble Average, SRES Emission Scenario A2



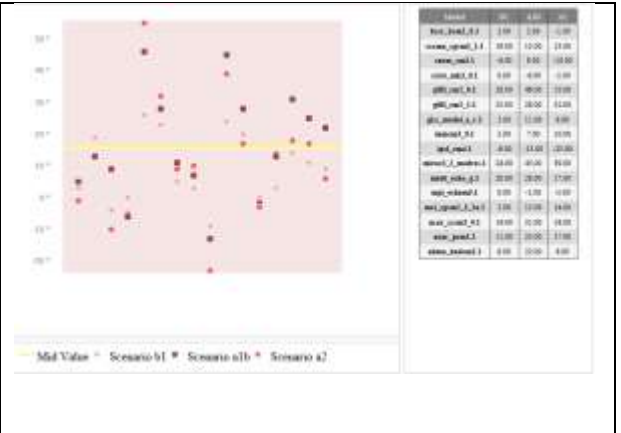
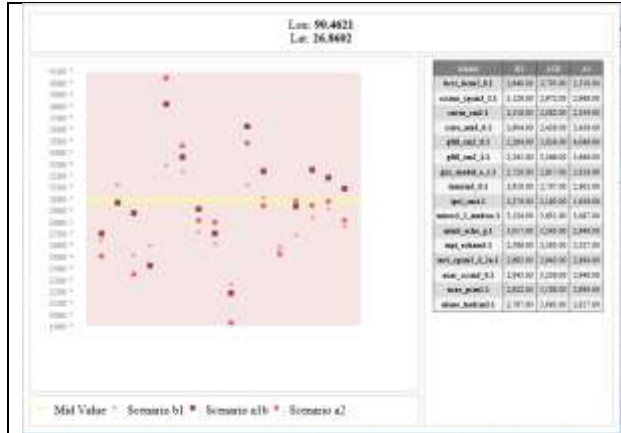


Figure 11. Gelephu Airport Average Annual Precipitation by 2050s, Ensemble Average, SRES Emission Scenario A2

Figure 12. Gelephu Airport Change in Annual Precipitation by 2050s, Ensemble Average, SRES Emission Scenario A2

VI. PUBLIC CONSULTATIONS AND INFORMATION DISCLOSURE

A. Public Consultation

160. Since the scope of overall Project is very small, and all the proposed constructions will be within the airport boundaries of BDA, YDA and GDA; the public consultations were limited mainly to Dzongkhag and Geog officials. For the stakeholder involvement, the following procedures were employed during IEE report preparation.

161. The DoAT officially informed the Dzongkhag administrations of Trashigang and Bumthang via its letter No.DoAT/ADD/2015-16/992 dated 3rd March 2016, regarding the conduct of public consultations with concerned stakeholders of the respective airports (Copies letter is attached as Annex 1 and 2. The Dzongkhag administrations further informed the affected Geog administrations of Choekhor and Kanglung respectively.

162. IEE team interacted with the relevant stakeholder like District Engineer, District Environmental officer, District Architect/municipal in-charge, District Land Record Officer and others during field survey to collect the public concerns and suggestions (see Annex 3 for the list of officials consulted).

B. Summary of consultations

1. Bumthang Domestic Airport

163. **December 18, 2015:** Dzongkhag/District Land Record Assistant (LRA) was consulted regarding the airport land ownership and its property boundary. The airport land ownership processing is stalled due to ambiguity on the organizational responsibilities. The airport now falls under the extended municipal boundary of Bumthang and therefore the municipal office is responsible for processing the airport land ownership certificate. However, the Bumthang municipal office is yet to be functional as it is under process of formation. The land ownership process can be completed only after establishment of functional municipal office is established with election of the Mayor.

164. **March 7, 2016:** Consultation meeting was held with District Environmental Officer (DEO) regarding the proposed construction of New Terminal building at BDA. The DEO was briefed on the nature, size and location of the terminal building to be constructed. The construction area will be strictly within the airport boundary. No private land acquisition will be required. There are no standing trees and the wildlife habitat that requires to be cleared. The discussion resulted to following understandings:

- Community clearance (no objection certificate) is not required;
- Forestry clearance is also not required
- Dzongkhag administrative clearance is required
- For the environmental clearance, IEE application form has to filled and submit directly to the NEC

2. Yonphula Domestic Airport

165. **December 20, 2015:** Consultation meeting was held with the airport management and discussed issues particularly airport land ownership. The land ownership is under

process similar to Bumthang and Gelephu airports. Unlike BDA and GDA, the proposed work at YDA is small in scope and expected no negative impacts.

166. **March 11, 2016:** Consultation meeting was held with the District Environmental Officer regarding the proposed erection of low level safety barrier on the southeast side of the apron. Since the nature and size of the work is so small, DEO felt that there is no need of filing of IEE application for this work item.

3. Gelephu Domestic Airport

167. **December 24, 2015:** District LRA was consulted regarding the airport land ownership status of Gelephu airport. The ownership certificate is under process and the DoAT will have to follow with the National Land Commission (NLC). If required, LRA advised the DoAT to process for provisional Land ownership certificate through district land record office.

C. Grievance Redress Mechanism

1. Mechanisms for resolution of conflicts and appeals procedures

168. A grievance redress mechanism will be established to receive and facilitate the resolution of concerns, complaints and grievances of affected people and relevant agencies on the social and environmental performance of the project in a time bound and transparent manner. The project specific GRM is not intended to bypass the government's own redress process, rather it is intended to address project affected people's concerns and complaints promptly, making it readily accessible to all segments of affected persons and is scaled to the risks and impacts of the project. While the affected person or party may submit their complaints concerning the project to any relevant agency, the steps recommended for the GRM are:

169. **Step 1:** If any affected person or party faces grievances related to environment or social concerns he/she can approach the contractor or construction supervision consultant or site staff of DOAT directly at the site level.

170. **Step 2:** If grievances are not addressed at the site level, the affected person or party can lodge a written grievance to the grievance redress committee (GRC) comprising of the Sector Heads of the Dzongkhag Administration as well as Geog Officials. The affected person or party may also skip step 1 and directly file written grievance to the GRC. All grievances which cannot be address at the site level should be forwarded to the grievance redress committee within 15 days from the receipt of complaint. The committee must respond within 15 days. Further, the GRC will treat grievances of both male and female affected persons equally and address them fairly.

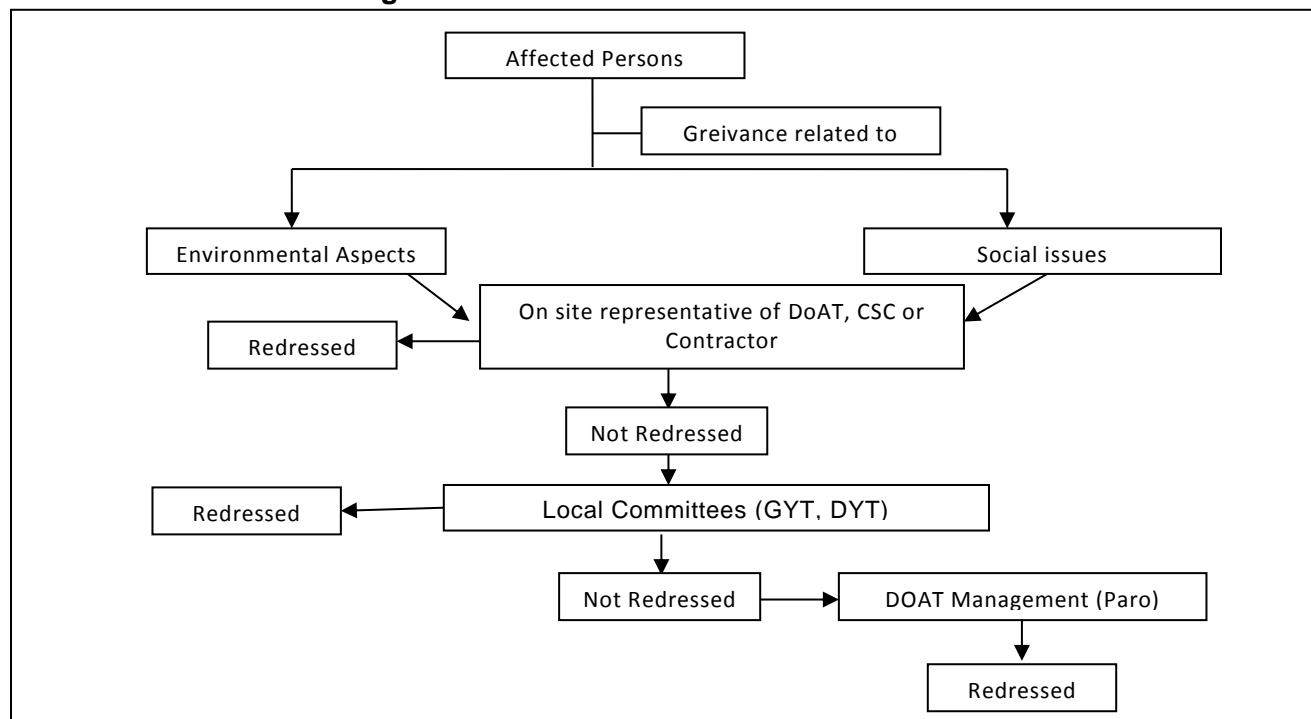
171. **Step 3:** If the affected person or party is not satisfied with the decision or he/she receives no response within 15 days of registering the grievance, he/she can approach the DOAT management and finally, can appeal to the Royal Government of Bhutan or His Majesty the King.

172. All complaints and grievances received must be clearly documented and included in the annual safeguards monitoring report for submission to ADB.

2. Procedures and Time Frame for Grievance Redressal

173. The detailed procedures for redressing grievances will be established for the project in order to create avenues for APs to express their grievances related to environment, land acquisitions and resettlements. Figure 14 shows the grievance redressal procedures:

Figure 14: Grievance Redressal Process



VII. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

174. The primary focus of the EMP is mitigation of environmental impacts occurring in the natural and social environment. The EMP consists of the following parts: (i) acquisition of prior clearances and no-objection certificates, (ii) a listing of environmental impacts and mitigation measures, responsibilities and their estimated costs; (iii) the environmental monitoring program for construction and operation periods; and (iv) the implementation framework of institutional and job responsibilities for mitigation and monitoring.

175. Mitigation measures that are the responsibility of the construction contractor which shall be included in the construction tender documents.

176. The respective project coordinator of the three domestic airports will also be the environmental safeguards focal persons at the site level, and will monitor implementation of the EMP by the contractor with the support of the environment specialist of the supervision consultants.

177. EMP implementation records in the form of monthly or quarterly checklists will be maintained by the contractor and cross checked and verified by the environment safeguards focal person at the site level. These will also be reviewed by the environment specialist of the supervision consultants. Based on these checklists and site observations, and records on grievances received and addressed the environment specialist will prepare an annual monitoring report and submit it to the overall environment safeguards coordinator under DOAT. After review and approval by DOAT, the report will be forwarded to ADB for disclosure on the ADB website in accordance with the requirements of ADB's SPS 2009.

A. Acquisition of Prior Clearances and No-objection Certificates

178. Table 16 summarizes the administrative clearances and no-objection certificates that are necessary for implementation of the construction works.

Table 16: Administrative Clearance and No Objection Certificates Required by the Project

Agency or Group	Purpose and Status	Responsible Party	Timeframe
National Environment Commission	Environmental clearance required for implementation ATCEP AF Status: To be processed	DOAT	Prior to construction
Dzongkhag	Administrative approval from Bumthang, and Sarpang Status: To be applied	DOAT	Prior to construction
BPCL	Requirement of additional power supply Status: To be processed	DOAT	Prior to construction
Gewog/Thromde	Usage of water resources Status: To be applied	DOAT	Prior to construction

B. Mitigation Measures

179. Table 17 summarizes the environmental impacts and proposed mitigation measures, along with their locations, that were identified in Chapter V. The table also prescribes implementation and monitoring responsibilities for the following groups: the

design consultant (DC) and the construction contractor (CC); the Department of Air Transport (DoAT), other national institutional authorities (identified by their common acronyms); and local authorities, Geog Administration (GA) or Dzongkhag administrations (DA). Implementation and monitoring responsibilities for a particular mitigation may be shared among these units.

Table 17: Environmental Management and Monitoring Plan

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
PRE-CONSTRUCTION PHASE									
1.	Detailed Design: Seismicity	Bhutan fall under high seismic risk zone IV and V. Seismic events may cause damage to structure and adjacent property, and result in loss of life.	<ul style="list-style-type: none"> To minimize seismic related structural damage and injury or loss of life. Detailed Consultant shall incorporate earthquake risk into the detailed design of new terminal building of BDA and Security Staff quarter of GDA. For analysis, design and detailing of structures, the design consultant shall refer to Bhutan Building Rules (BBR) 2002. For analysis of structure BBR code 9.2.2 IS 1893 – criteria for earthquake resistant design of structures, For design of structure, BBR code 9.3.2 IS 4326 – Earthquake resistant design and construction of building, For detailing of structure, BBR code 9.4.2 IS 13920-1993; Ductile detailing of concrete structures subjected to seismic forces. 	Design office	<u>Monitoring Indicator:</u> Earthquake risk design <u>Performance Indicator:</u> IS 1893, IS 4326, and IS 13920-1993 earth resistant analysis, design and detailing of structures carried out.	Review of Design Documents of BDA and GDA	Design Consultant	Project Coordination Unit (PCU)	Once before the finalization of the design.
CONSTRUCTION PHASE									
2.	Earthwork, Excavation	Construction of low level safety	<ul style="list-style-type: none"> Excavated material/spoil 	YDA	<u>Monitoring Indicator:</u>	Site investigatio	Construction Contractor	Construction Supervision	PCU and CSC shall regularly

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
	and Spoil Disposal	<p>barrier at YDA will require minimal earthwork and excavation.</p> <p>Similarly, the construction of new terminal building at BDA and construction security staff quarter at GDA will require small excavation for building foundation. Excavated material if not managed properly cause dust pollution, downstream siltation and erosion.</p>	<p>from YDA safety barrier construction shall not be dumped into the natural drainage. The spoil shall be used to fill and level along the edge of runway.</p> <ul style="list-style-type: none"> Excavated material from BDA's new terminal building works shall be disposed off to the designated dumpsite southwest of runway as shown in figure 11. Excavated material from GDA's security quarter construction works shall be disposed off to the designated dumpsite behind the construction site as shown in figure 12. All disposal areas shall be compacted, watered and properly fenced to prevent dust pollution and soil erosion. 	<p>BDA</p> <p>GDA</p>	<p>soil disposal practice, location of dumpsite</p> <p><u>Performance Indicators:</u> No or less dust pollution,</p> <p>Spoil dumped at designated dump sites,</p> <p>Dumpsites are properly compacted and watered regularly.</p>	<p>n and Observations</p> <p>Review of project documents</p> <p>Discussion with project officials</p> <p>Discussion with local people</p>		<p>Consultant (CSC), Environmental Specialist (ES) and Project Coordination Unit (PCU)</p>	<p>monitor during excavation and spoil disposal.</p> <p>ES shall monitor at least two a year.</p>
3.	Transportation or haulage of construction materials for airport improvement works	<p>Haphazard quarrying will cause severe environmental damages such as slope failure, soil erosion, surface water pollution and siltation downstream.</p>	<ul style="list-style-type: none"> Construction material such as stone aggregates and sand shall be sourced from RGOB approved existing mines at Bumthang, Gelephu and Trashigang. Contractor shall mandate the material transporter to comply with good practices of material transportation. All vehicle carrying 	<p>YDA</p> <p>BDA</p> <p>GDA</p>	<p><u>Monitoring Indicator:</u> Legal status of quarries where materials are being sourced from;</p> <p>Status of vehicle registration</p>	<p>Site investigation and Observations</p> <p>Review of project documents</p> <p>Discussion</p>	<p>Construction Contractor</p>	<p>Construction Supervision Consultant (CSC), Environmental Specialist (ES) and Project Coordination Unit (PCU)</p>	<p>CSC shall regularly monitor during excavation and spoil disposal.</p>

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
		Haulage of construction materials to construction sites will cause air pollution due to vehicular emission and dust from exposed construction materials.	<p>hazardous, dust generating construction material shall be properly covered during transportation to minimize dust pollution.</p> <ul style="list-style-type: none"> All access roads wherever there are possibilities of generating dust pollution within contractors' jurisdiction shall be sprayed with water at least twice daily. Contractor shall demand the transporters to carryout vehicular emission testing to limit the exhaust related pollution. Similarly contractor shall carryout regular maintenance of transport and construction vehicles/machineries. 		<p>documents (renewed or not);</p> <p>Presence/absence of covers on transport vehicles;</p> <p><u>Performance Indicators:</u> Construction material purchased from RGOB approved mines only;</p> <p>No Vehicular without up to date emission testing and servicing.</p> <p>All trucks carrying construction materials covered during transportation.</p>	<p>with project officials</p> <p>Discussion with local people</p>			
4.	Water Environment (Surface and ground water)	During construction surface and ground water resources may	<ul style="list-style-type: none"> Discharge of sediment laden construction water directly into surface water bodies shall be avoided. Wastewater/sewage and 	YDA BDA GDA	<p><u>Monitoring Indicator:</u> Construction debris disposal method, waste</p>	Site investigation and Observations	Construction Contractor	Construction Supervision Consultant (CSC), Environment	PCU and CSC shall regularly monitor during excavation and spoil

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
		be affected by accidental spillage hazardous substances into surface water at Bumthang and Yonphula; and groundwater at Gelephu airport.	<p>hazardous waste shall not be dumped into the surrounding to prevent surface and ground water contamination. Pit toilet constructed Gelephu airport shall be lined with cement to prevent leakage of sewage into the ground water chamber,</p> <ul style="list-style-type: none"> • Dumping of construction waste into storm water drainage shall be avoided minimize the siltation of pond water at Yonphula airport, 		<p>water disposal or sewage management method</p> <p>Presence/absence of cement lining of Pit toilet at Gelephu airport</p> <p>Presence/absence of murky water in the Yonphula pond</p> <p><u>Performance Indicators:</u> Construction debris, wastewater/sewage not dumped directly into water bodies</p>	<p>Review of project documents</p> <p>Discussion with project officials</p> <p>Discussion with local people</p>		<p>Environmental Specialist (ES) and Project Coordination Unit (PCU)</p>	<p>disposal.</p> <p>ES shall carry out intermittent monitoring</p>
5.	Solid Waste	During construction, both domestic and construction waste will be generated. Construction waste is difficult to estimate. So only domestic	<ul style="list-style-type: none"> • Construction worker shall sort their garbage into biodegradable and non-biodegradable • For all campsites, the contractors shall construct garbage pits. • Biodegradable waste shall be put into garbage pit while non-biodegradable 	<p>YDA</p> <p>BDA</p> <p>GDA</p>	<p><u>Monitoring Indicator:</u> Presence/absence of garbage pits, waste segregation into degradable and non-degradable</p>	<p>Site investigations and Observations</p> <p>Review of project documents</p>	Construction Contractor	<p>Construction Supervision Consultant (CSC), Environmental Specialist (ES) and Project Coordination Unit (PCU)</p>	<p>CSC shall regularly check waste management by the contractor.</p> <p>ES shall carry out intermittent</p>

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/Frequency
		<p>wastes are estimated: DBA – 252 kg per week by 20 construction workers</p> <p>YDA – 189 kg per week for 15 construction workers</p> <p>GDA – 252 kg per week by 20 construction workers.</p>	<p>waste shall be handed over to scrap dealer for recycling.</p> <ul style="list-style-type: none"> After completion of usage of garbage pit, the contractor shall decommission the pit by covering with soil and suitably compact it to prevent of leakage. Hazardous waste such as spent batteries, acidic substances and used fuels shall be stored properly and handed over to waste recycling businesses/agencies. 		<p>ongoing or not, Conditions of garbage pits after decommissioning of garbage pits, quantity of waste recycled, Hazardous waste storage conditions</p> <p><u>Performance Indicators:</u> Garbage pits constructed; Waste separation carried out; Waste recycling carried out; Garbage pits decommissioned; Hazardous waste stored properly and sent for recycling.</p>	<p>Discussion with project officials</p> <p>Discussion with local people</p>			monitoring
6.	Sewage/Waste Water	Dumping of wastewater and sewage into surrounding environment	<ul style="list-style-type: none"> For sewage/wastewater treatment ordinary pit toilet will be constructed at BDA and YDA campsites; However, for GDA, cement 	YDA BDA GDA	<u>Monitoring Indicator:</u> Presence/absence of ordinary pit toilets at	Site investigation and Observations	Construction Contractor	Construction Supervision Consultant (CSC), Environment	CSC shall monitor during the pit toilet construction and

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
		without treatment will pollute water resources. Estimated sewage/Wastewater generation for each airports: BDA-1000litres per day YDA-750litres per day GDA-1000litres per day	lined pit toilet shall be constructed to prevent leakage of untreated sewage into underground water chamber; <ul style="list-style-type: none"> Pit toilets once completed their usage shall be decommissioned by covering with soil and compacting it to prevent leakage of sewage into surrounding environment. 		BDA & YDA; Construction of cement line pit toilet at GDA; Conditions of pit latrines after decommissioning <u>Performance Indicators:</u> Pit toilets constructed at BDA & YDA; Lined pit toilet constructed at GDA; And Pit toilets decommissioned by covering with soil and compacted. No leakages.	Discussion with project officials		al Specialist (ES) and Project Coordination Unit (PCU)	decommissioning period. ES shall carryout monitoring intermittently and at final decommissioning period.
7.	Air Environment	During site clearance and earthwork, there will be a temporary adverse impact on ambient air quality in terms of increased dust suspension and gaseous emission from vehicles and	<ul style="list-style-type: none"> Regular spraying of the work area and haulage route. River water from Chamkhar chhu could be used for spraying the work area at BDA; Stream water Barizhong under Khaling Geog could be used for YDA; and Gelephu airport ground water from bore well could be used for dust suppression at GDA. covering construction 	YDA BDA GDA	<u>Monitoring Indicator:</u> Complaints of dust from local community, Number of times per day/week water is sprayed on construction site Availability of face masks	Site investigation and Observations Discussion with project officials and construction workers	Construction Contractor	Construction Supervision Consultant (CSC), Environmental Specialist (ES) and Project Coordination Unit (PCU)	CSC shall regularly monitor during construction period. ES shall carryout monitoring intermittently

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
		construction equipment.	material during transportation; <ul style="list-style-type: none"> • Timely and regular maintenance of construction equipment and machineries to reduce gaseous emissions; • Provision for gas/facemasks for construction workers to prevent direct inhalation of dust 		<u>Performance Indicators:</u> No public complaint of dust pollution; Gasmask provided to workers				
8.	Noise Environment	Construction zones at BDA, YDA and GDA are more than 300m away from the nearest settlements. Therefore noise pollution will not be an issue for the settlements near BDA, YDA and GDA. Construction noise will only have impact on the labourers working for the project.	<ul style="list-style-type: none"> • Limit the working hours to daylight hours (8am-5.30pm) • Provision for ear plugs and use of construction equipment that produce less noise. 	YDA BDA GDA	<u>Monitoring Indicator:</u> Daylight working hours; provision for ear plug; Complaints from local people <u>Performance Indicators:</u> Working hours limited daylight hours; Workers provided with earplugs; No compliant on noise from local people.	Site investigation and Observations Discussion with project officials and construction workers	Construction Contractor	Construction Supervision Consultant (CSC), Environmental Specialist (ES) and Project Coordination Unit (PCU)	CSC shall regularly monitor during construction period. ES shall carryout monitoring intermittently
9.	Ecological Environment	BDA, YDA and GDA subprojects	<ul style="list-style-type: none"> • Contractor shall provide cooking fuel either LPG or 	YDA	<u>Monitoring Indicator:</u>	Site investigatio	Construction Contractor	Construction Supervision	CSC shall regularly

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
	: Pressure on Forest product	will import roughly 20, 15, and 20 construction workers respectively. The presence of foreign workers though not very significant may give rise to competition or pressure on local forest produce.	the fuelwood from the legal supplier to reduce competition local forest supply; <ul style="list-style-type: none"> Contractor shall make timely wage payment for labourers to buy food stuff to prevent labourers from foraging for forest produce in competition to local population. 	BDA GDA	Type of cooking fuel; and timely wage payment <u>Performance Indicators:</u> Kerosene or Cooking gas supplied; Wage paid on time; and no competition to local community for forest produce	n and Observations Discussion with project officials, construction workers; and local community		Consultant (CSC), Environmental Specialist (ES) and Project Coordination Unit (PCU)	monitor during construction period. ES shall carryout monitoring intermittently
10.	Ecological Environment : Impact on wildlife and habitat	There will be no direct impact on wildlife and their habitats by all three domestic airport improvement works of BDA, YDA and GDA. The anticipated impact on wildlife may stem as result of illegal fishing, trapping and hunting of wildlife in the vicinity of the project area by the construction workers.	<ul style="list-style-type: none"> PCU/Contractor in coordination with Forest Range Office at Bumthang shall carry out awareness campaign to deter illegal fishing in Chamkhar Chhu. Similarly, PCU/Contractor along with Forest Range office of Yonphula and Gelephu shall carry out awareness campaign to deter wildlife poaching, trapping and hunting etc. Forest officials from respective project areas of Bumthang, Yonphula and Gelephu shall make surprise checking to discourage the construction workers from 	YDA BDA GDA	<u>Monitoring Indicator:</u> Records of incidents of illegal fishing; Awareness campaign of illegal activities carried out or not; <u>Performance Indicators:</u> Awareness campaign on illegal hunting and fishing carried out; incidents of illegal activities	Site investigation and Observations surprise checking Discussion with project officials, construction workers; and Local Forest offices, local community	Construction Contractor	Construction Supervision Consultant (CSC), Environmental Specialist (ES) and Forest Officials	CSC shall regularly monitor during construction period. Forest Official conducts random checking ES shall carryout monitoring intermittently

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
			<p>illegal activities;</p> <ul style="list-style-type: none"> Contractors shall be held accountable for any illegal activities that are carried out by their workforce. 						
11.	Socio-economic Environment : Occupational Health and Safety	<p>During construction the health and safety of the workforce is at risk due to an accident prone working environment, long shifts and through poor accommodation at campsites. These health and safety issues can occur at all three project sites of BDA, YDA and GDA</p>	<ul style="list-style-type: none"> Construction workers shall be provided with adequate and appropriate shelter which are wind and rainproof; Camps shall be located within the airport boundaries away from the local settlements; First aid kit shall be provided for all the project sites In an emergency, workers shall be allowed avail the medical services at Bumthang, Trashigang and Gelephu hospitals free cost. Clean drinking water, construction of pit toilets, and garbage disposal sites shall be provided; Labour officers of respective regions of Gelephu, Trashigang and Bumthang shall make surprise check on compliance of occupational health and safety. 	YDA BDA GDA	<p><u>Monitoring Indicator:</u> Types of shelter; camps location; presence/absence of first aid kit; Clean drinking water; proper toilet and garbage disposal site;</p> <p><u>Performance Indicators:</u> Weather proof Camps are built; Clean drinking water, toilets and garbage disposal are provided; First aid and medical services are provided in an emergency.</p>	<p>Site investigation and Observations</p> <p>Discussion with project officials, construction workers; and labour offices, local community</p>	Construction Contractor	<p>Construction Supervision Consultant (CSC), Environmental Specialist (ES) and Labour Officers from regional office of Ministry of Labour and Human Resources</p>	<p>CSC shall regularly monitor during construction period.</p> <p>Labour Officer conducts random checking during construction period</p> <p>ES shall carryout monitoring intermittently</p>
12.	Socio-economic	During construction	Although RGOB makes it mandatory for the labourers	YDA	<u>Monitoring Indicator:</u>	Site investigation	PCU and Contractor	Construction Supervision	CSC shall regularly

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
	Environment : HIV/AIDS and Communicable Diseases; Gender violence and Human trafficking	phase, project will employ construction workers (both local and foreigners). Presence of foreign work force increase the chances of spread of communicable diseases such as HIV/AIDS, tuberculosis etc.	to check for communicable diseases before the issuance of the work permits to prevent spread of diseases; still the project shall carryout following measures to minimize the risk of spread of communicable diseases and the gender issues: • Project shall invite Health officials from respective project sites of Bumthang, Yonphula and Gelephu to provide awareness education on communicable diseases to the construction workers;	BDA GDA	Records on health awareness campaign carried out; and Gender violence, child protection and Human trafficking awareness; <u>Performance Indicators:</u> HIV/AIDS and communicable disease awareness campaign carried out; Awareness on gender equality, violence; child protection and human trafficking carried out.	n and Observations Discussion with project officials, and construction workers;		Consultant (CSC), Environmental Specialist (ES)	monitor during construction period. ES shall carryout monitoring intermittently
OPERATIONAL PHASE									
13.	Air and Noise Environment	Due to larger airport terminal building and other improved facilities at the airports of BDA, YDA and GDA	Although air and noise pollution will not be severe as the air traffic is only limited to 2 flights per week. And it will remain low for foreseeable future. Nonetheless following	YDA BDA GDA	<u>Monitoring Indicator:</u> Noise level; Ambient air quality (PM10, TSPM, Sox, Nox, CO)	Site investigation and Observations	BDA management YDA management GDA	Dzongkhag Environmental Officers (DEO) of Bumthang, Sarpang and Trashigang	DEO shall monitor air and noise quality once a year.

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
		will facilitate the increased number of aircraft operations. These will inevitably lead to some increase in air and noise pollution.	measures are recommended to further minimize the air and noise pollution: <ul style="list-style-type: none"> • Shut down of engines to the maximum extent possible during taxiing and idling period • Allowing aircrafts with ICAO certified engines to land and takeoff, as far as possible The ICAO Balanced Approach concept provides airports with an agree methodology to be used to address and manage aircraft noise problems in an environmentally responsive and economically responsible way. The Balance Approach to noise management encompasses four principal elements: <ul style="list-style-type: none"> • Reduction of noise at source • Land use planning and management • Noise abatement operational procedures • Operating restrictions on aircraft 		levels <u>Performance Indicators:</u> Noise level within national set limit of mixed area; Ambient air quality (PM10, TSPM, Sox, Nox, CO) levels are within national limits.	Review of Project Documents	management		
14.	Waste Management: Solid Waste	By assuming that there will be two flights per week for all three domestic airports	<ul style="list-style-type: none"> • Airport management of BDA, YDA and GDA shall sort their waste into biodegradable and non-biodegradable. 	YDA BDA GDA	<u>Monitoring Indicator:</u> Waste segregation; Waste	Site investigation and Observations	BDA management YDA management	Dzongkhag Environmental Officers (DEO) of Bumthang,	DEO shall monitor handling of solid waste by Airport

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
		(BDA, YDA and GDA) during operation. Each airport will handle at least 80 people which include airport staff, crews and passengers. The estimated solid waste generation will be roughly around 252kg per week and monthly around 1000kg. Improperly dumping of these waste pollute surrounding and water bodies.	<p>Biodegradable shall be recycled or disposed of to the landfill;</p> <ul style="list-style-type: none"> • Non-biodegradable waste such as plastics, pet bottle, bottles, metal scraps, papers etc. could sold or handed over scrap dealer for recycling. • Hazardous waste such as spent batteries, acidic substances and used fuels shall be properly stored and sent for recycling to India. 		<p>recycling; Hazardous waste storage and recycling;</p> <p><u>Performance Indicators:</u> Waste segregated into biodegradable and non-degradable;</p> <p>In-organic and hazardous wastes stored and recycled.</p>	Review of Project Documents	GDA management	Sarpang and Trashigang	Management on ad hoc basis.
15.	Waste Management: Sewage/ Wastewater	Using WHO standards, it is estimated that each airports will generate 4000 liters wastewater/Sewage per week. Dumping this wastewater without treatment will pollute local water resources and cause water borne disease.	<ul style="list-style-type: none"> • BDA and GDA buildings constructed shall have independent septic tanks and soak pits for wastewater treatment to prevent pollution of local water resources • Septic tanks and soak pits shall be replaced with more advance wastewater treatment plant such as Sequential Batch Reactor (SBR) in future as the amount of wastewater generation increases 	YDA BDA GDA	<p><u>Monitoring Indicator:</u> Septic tanks and soak pit waste water treatment; Installation of advance wastewater treatment facility</p> <p><u>Performance Indicators:</u> Septic tanks</p>	Site investigation and Observations Review of Project Documents	BDA management YDA management GDA management	Dzongkhag Environmental Officers (DEO) of Bumthang, Sarpang and Trashigang	DEO shall monitor handling of wastewater by Airport Managements on ad hoc basis.

S.No	Activities /Issues	Adverse Impacts	Mitigation Measures	Location	Monitoring Indicator & Performance Target	Monitoring Methods	Responsible Implementing Agency	Responsible Monitoring Agency	Schedule/ Frequency
			beyond the capacity for septic tanks and soak pits to handle.		and soak pit constructed; Advance wastewater treatment Plant installed in future				

VIII. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

180. Since the scale of existing domestic airport improvement project (Air Transport Connectivity Enhancement Project Additional Financing) is very small, it will have minimum impact on environment; as almost all the construction activities will be limited and carried out within the airport boundaries. From the IEE studies, it can be safely concluded that all three domestic airports of BDA, YDA and GDA:

- Do not fall under any protected and restricted forest areas, or biological corridors connecting protected areas of Bhutan;
- There will be no forest clearance or tree felling required;
- No private structure and land acquisition is required since project sites are all within the airport boundaries;
- Hence no resettlement is anticipated;

B. Recommendations

181. The environmental impacts predicted for ATCEP-AF are predicted to be insignificant since the impacts are temporary, reversible and can easily be mitigated using available methods. The mitigation measures proposed in the IEE/EMP are sufficient. However, few specific recommendations are made to resolve the anticipated environment issues of that may arise due to implementation of ATCEP AF:

- Environmental conditions shall be incorporated into standard bidding document and EMP shall be attached with Bid document.
- Project Coordinators for respective subprojects (Bumthang, Yongphula and Gelephu airports) under ATCEP AF shall act as Environmental Focal Person and report to the Overall Environmental Monitoring In-Charge (in this case Director of DoAT).
- DoAT (or Environmental Monitoring In-Charge) shall submit a annual environmental monitoring report on EMP implementation to ADB and the relevant government agencies.
- At the implementation stage, other relevant agencies such as Dzongkhag Administration, Department of Forests and Park Services, National Environment Commission shall monitor the implementation of mitigation measures as specified under the EMP.

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Annex 1: Letter to Bumthang Dzongkhag for Public Consultation



ཅམ། ལན་མ་གྱི་རྒྱལ་འབྲེན་ལས་ཁྲུང་ལ།
 ཅམ་ ལན་དོན་དང་ལུང་ལཱ་རྒྱུ་ལ། དཔལ་ལྷན་ལུགས་ལུང་
 Department of Air Transport
 Paro International Airport
 Ministry of Information & Communications
 Royal Government of Bhutan



DoAT/ADD/2015-16/ 992

3rd March 2016

Dasho Dzongdag
 Dzongkhag Administration
 Bumthang

Subject: Fielding of Consultant for public consultation

Respected Dasho,

Our department has requested the Asian Development Bank for an additional financing for the ongoing Air Transport Connectivity Enhancement Project (ATCEP). And for the preparation of additional financing project, we are required to carry out an Environmental and Social Compliance monitoring of the ongoing project along with the social due diligence reporting for the future additional financing of ATCEP.

As part of the compliance monitoring and social due diligence assessment; the consultant plans to carry out field investigations and public/stakeholder consultations on the following issues that are directly relevant to the project:

1. Consultation with Dzongkhag Administration and affected communities on bank erosion due to Chamkar Chhu diversion.
2. Consultation with the community that had been using the footbridge
3. Consultation with Dzongkhag Administration on the plan and timeline of reconstruction of foot bridge /vehicular bridge north of Batapalathang
4. Consultation with Brown Swiss Farm, Department of Livestock on relocation status and timeline for completion of relocation.

Therefore, you are kindly requested to render necessary assistance by informing the respective officials of the project influence area including Gewog Administrations and other stakeholders for the conduct of public consultations.

Yours Sincerely,


 Ngyen Dorji
 Offg. Director

Cc:

1. Bumthang Domestic Airport Manager for information and necessary coordination
2. Project Coordinator, ADB Projects, ADD, DoAT for information
3. Karma Chogyel, Staff Consultant, ADB for information

Post Box No. 1299, Paro Int. Airport, Tel: (+975) 8-271403, Fax: (+975)-8-271751 Email: kwirjchuk@dca.gov.bt
 Website: <http://www.dca.gov.bt>

Annex 2: Letter to Trashigang Dzongkhag for Public Consultation



ཕུམ་ལྷོ་གྲོལ་གྱི་འཕེལ་རྒྱུ་ལྷན་ཁག།
 མཉེན་འཛུགས་དང་འབྲུག་ལྗོངས་དཔལ་འབྱོར་ལྷན་ཁག།
 Department of Air Transport
 Paro International Airport
 Ministry of Information & Communications
 Royal Government of Bhutan



DoAT/ADD/2015-16/992

3rd March 2016

Dasho Dzongdag
 Dzongkhag Administration
 Trashigang

Subject: Fielding of Consultant for public consultation

Respected Dasho,

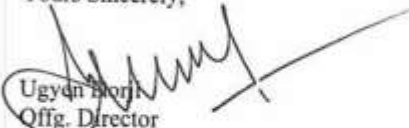
Our department has requested the Asian Development Bank for an additional financing for the ongoing Air Transport Connectivity Enhancement Project (ATCEP). And for the preparation of additional financing project, we are required to carry out an Environmental and Social Compliance monitoring of the ongoing project along with the social due diligence reporting for the future additional financing of ATCEP.

As part of the compliance monitoring and social due diligence assessments, the consultant plans to carry out field investigations and public/stakeholder consultations on the following issues that are directly relevant to the project:

1. Consultation with Yonphula Community and Kanglung Gewog Administration on inclusion/exclusion of pond at Yonphula
2. Consultation with communities of Yonphula/Khenthong Mani on alternative foot trail outside Yonphula airport boundary
3. Consultation with Yonphula community about satisfaction with Yulgy Namgyel Chorten at Yonphula.
4. Consultation with community members about storm water drainage and their impacts on their settlements.

Therefore, you are kindly requested to render necessary assistance by informing the respective officials of the project influence area including Gewog Administrations and other stakeholders for the conduct of public consultations.

Yours Sincerely,


 Ugyen Dorji
 Offg. Director

Cc:

1. Yonphula Domestic Airport Manager for information and necessary coordination
2. Project Coordinator, ADB Projects, ADD, DoAT for information
3. Karma Chogyel, Staff Consultant, ADB for information

Post Box No. 1299, Paro Int. Airport, Tel: (+975) 8-271403, Fax: (+975)-8-271751 Email: kwingchuk@dca.gov.bt
 Website: <http://www.dca.gov.bt>

Annex 3: List of Officials Consulted

Sl. No.	Name	Designation	Department/Agency
1.	Karma Wangchuk	Director	Department of Air Transport
2.	Ugyen Dorji	Chief Engineer	Department of Air Transport
3.	Tashi Lhamo	Airport Manager	Bumthang Domestic Airport
4.	Namgay	Technician	Bumthang Domestic Airport
5.	Yeshi Dorji	District Engineer	Bumthang Dzongkhag Administration
6.	Tshering	Architect	Bumthang Dzongkhag Administration
7.	Pema Lhaden	Land Record Assistant	Bumthang Dzongkhag Administration
8.	Jigme Choki	Dzongkhag Env. Officer	Bumthang Dzongkhag Administration
9.	Pema Doengyel	Gaydrung/Geog Clerk	Chhokhor Geog, Bumthang
10.	Jangchuk	Tshogpa	Tamzhing, Chhokhor Geog, Bumthang
11.	Karma	Thromde Thueme	Chamkar Thromde, Bumthang
12.	Tshewang Penjor	Farm Manager	Brown Swiss Cattle Farm
13.	Dorji Samdrup	Livestock Production Supervisor	Brown Swiss Cattle Farm
14.	Tandin Dorji	Environment Officer	Trashigang Dzongkhag Administration
15.	Kinzang Dorji	Gup	Kanglung Geog, Trashigang
16.	Ngawang Thinley	Tshogpa	Yonphula, Kanglung Geog, Trashigang
17.	Tshuelthrim Drakapa	Airport Manager	Yongphula Domestic Airport
18.	Tshewang Namgyel	Land Record Assistant	Sarpang Dzongkhag Administration
19.	Chhimi Dolkar	Social Safeguard	Gyaltshen Consultancy
20.	Ugyen Dorji	Environmental Expert	Gyaltshen Consultancy